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G.C.M.I. Meeting Hails Continued Growth

R. L. Cheney, GCMI Director of Market Research and Promotion.

The Twelfth Annual Meeting of the Glass Container Manufacturers Institute was called to order by retiring president Royden A. Blunt at the Greenbrier, White Sulphur Springs, West Virginia, on Monday morning, May 21st.

Commenting on the expansion of business in all lines of endeavor, Mr. Blunt noted that the meeting itself was following the trend by reaching a new high in attendance, approximately 300 persons.

In referring to the current position and objectives of the industry, Mr. Blunt pointed out that the glass container industry was not only a mass production industry, but also that its methods of manufacture involve a continuous process, with the result, that characteristic of industries in this category, the glass manufacturers' primary concern must be a sustained high demand for his product.

"This," said Mr. Blunt, is tantamount to saying that the industry's trend varies more or less directly with the trend of total business of the country.

Mr. Blunt mentioned, at this point, that a review of the general business outlook for 1956, with special reference to glass containers, would be presented by C. C. Merrifield of The Econometric Institute.

As a backdrop to Mr. Merrifield's talk Mr. Blunt offered some statistics portraying the industry's steady growth.

After pointing out that for the first four months of 1956, shipments of glass containers were four per cent over the corresponding period of a year ago he emphasized the fact that this was really phenomenal, considering the substantial growth of the past five years. He then proceeded to dramatize the industry's progress by comparing its volume with the gross national product.

Mr. Blunt stated, "In order to show the progress being made by our industry over the past several years, I have compared our glass container volume figures with the gross national product. We have used the base period of 1947-1949 as equaling 100 and the gross national product figure has been adjusted, eliminating the dollar inflation.

"At the end of 1955, these different series stood as follows as compared with 1947-1949:

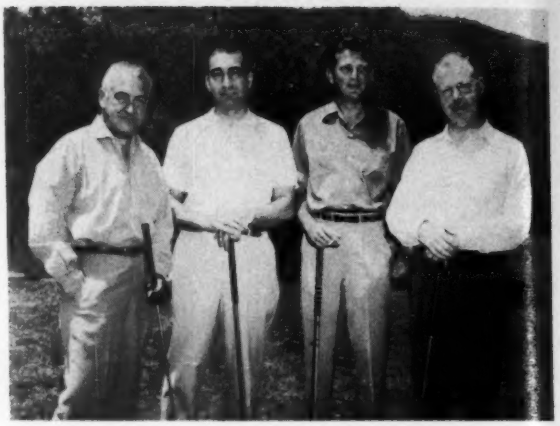
Gross national product (1947-1949 dollars)	136
Glass container shipments in gross	135
Glass container shipments in pounds	127
Average bottle weight	95
Stocks on hand	148

"From the above you will see that there was only one point difference in the progress made by our glass container shipments as compared with gross national product after eliminating the price inflation from the latter figure. For the seven years, starting with 1949, this represents an increase of five points a year, which is certainly substantial growth."

The lesser increase in pounds shipped, as compared to gross shipped, is understandable—in view of the fact that the average bottle weight, or average weight per gross, dropped five points during the period. Of course, the variety of capacity sizes during the period could account for the above reduction but from what we know of the size containers used in the various lines, we believe that the overall average capacity size is probably larger today than it was seven years ago. If this is true, it means that the effective weight reduction during the period has amounted to more than the five points indicated."

As is customary, the G.C.M.I. membership was supplied with written reports of the nine standing com-

(Left to right) M. J. Jones, Obear-Nester Glass Co.; R. M. Lamb, Jr., Lamb Glass Co.; J. M. Foster, Foster-Forbes Glass Co.; S. L. Rairdon, Owens-Illinois Glass Co.



(Left to right) J. S. Heuisler, Maryland Glass Corp.; E. M. Terner, Metro Glass Bottle Co.; William J. Green, Thatcher Glass Mfg. Co., Inc.; George Winner, Counsel to Thatcher Glass Mfg. Co., Inc.

(Left to right) J. W. Fisher, Ball Bros. Co., Inc.; J. C. Feagley, Armstrong Cork Co.; V. L. Hall, GCMI General Manager; P. G. Fuger, Wyandotte Chemicals Corp.

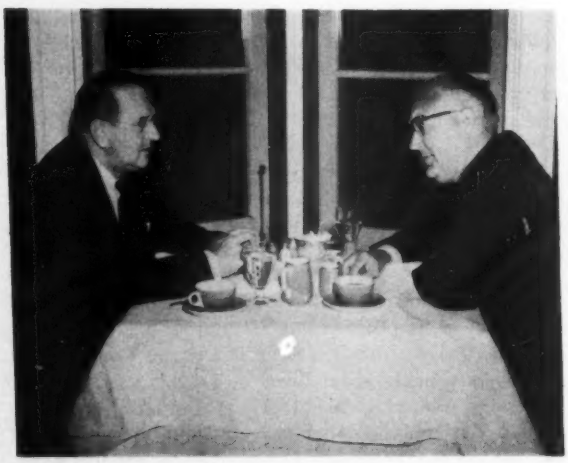
mittees and a number of sub-committees which report periodically to the Board of Trustees.

In view of this, and the fact that some of these reports were to be supplemented by oral presentation, Mr. Blunt stated that he would forego detailed discussion of the work of these committees. Mr. Blunt did, however, lay particular emphasis on the public relations activities of the Institute.

In concluding his address, Mr. Blunt said, "My experience as head of your Institute during this past year has convinced me that we have an intelligent, hard-working staff and I believe that progress is being made on the various problems. When a problem appears, which in your opinion represents an industry problem and is not being handled, we hope you will let the Institute know, or, if you prefer, pitch the matter directly to the Board of Trustees.

"Tomorrow ends my duty as your president and, as well, trustee, since prior to this past twelve months I had two terms as a trustee. I have thoroughly enjoyed

(*Continued on page* 400)



Dr. Norman Vincent Peale (Left); Fred E. Fuller, Counsel to GCMI (Right).

(Left to right) C. G. Bensinger, Owens-Illinois Glass Co.; Fred E. Fuller; H. C. Herger, Pierce Glass Co.; R. L. Cheney, GCMI.

Acid-Base Relationship in Glass Systems

DEVELOPMENT OF AN OXYGEN ELECTRODE FOR MEASUREMENTS OF ACID-BASE PROPERTIES OF GLASSES

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ABSTRACT

A concentration cell has been constructed consisting of two oxygen electrodes and a combination of two glasses as electrolyte. The EMF of the cell is related to the relative basicity of the two glasses.

The basicities of glasses of different compositions, but containing only one kind of alkali ions, have been compared. It is found that an alkaline earth oxide when added to an alkali silicate glass decreases the basicity of the glass strongly.

The EMF has also been measured for cells in which the two glasses contain mixtures of alkali ions in different ratios.

I. Introduction

a. *The Oxygen Electrode and the Oxygen Ion Activity*

The oxygen ion is the chief negative building unit of most glasses, slags, and many of the common salts containing complex anions, e.g., sulfates. The free gaseous oxygen ion is unstable. It can only exist when it is surrounded by electropositive cations with high field strength.

A mixture of two or more oxides, containing only one negative building unit, may conveniently be described as a mixture of a number of different oxygen ions in different energy states or states of polarization. A reaction involving oxides may, therefore, be described as a transfer of oxygen ions from one state of polarization to another. If this transfer can be carried out in a reversible cell, one may obtain the free energy change for the transfer.

The electrode reaction of a cell transferring O^{2-} ions would be as follows: $O^{2-} = O + 2\ e$, a reaction which could take place, for example, at a platinum surface. Here the oxygen atoms could combine and form O_2 molecules. The cell could be a concentration cell with transference, e.g.,

(Pt) O_2; Oxide Sytem I: Oxide System II; O_2 (Pt.)

When a current passes through this cell, O^{2-} ions will be discharged at one electrode and O_2 molecules will be changed into O^{2-} ions at the other electrode. If there is no liquid junction potential of significance, the electrical potential measured for the cell gives the free energy change by the transfer.

The basicity of an oxide system may be defined as the partial free energy or the activity of the oxygen ions in the system in the same fashion as the activity of protons is used for measuring the acidity of an aqueous solution [1] [2]. A detailed discussion on the acid-base concept in aqueous and non-aqueous systems has been presented by W. A. Weyl[3]. The potential of the cell above will thus give the relative basicity of the two oxide systems. Now, of course, as we pass a current through the cell, we will have an electrolytic transport of electricity from one side of the cell to the other. This transport will usually be performed by the singly charged cations, e.g., the Na^+ ions in a sodium silicate, so the total cell reaction will consist of the transport of an oxide, e.g., Na_2O, from the one side to the other; and, consequently, the measured potential gives the free energy change or the activity of this oxide. The activity or partial free energy of Na_2O in the sodium silicate may thus be taken as a measure of the basicity of the system. If the activity of Na_2O is chosen as a measure of the basicity, the basicity scale will go from 1 for pure Na_2O to 0 for extreme acid systems. If the partial free energy of Na_2O is chosen as the measure of the basicity, the scale will go from 0 to $-\infty$.

b. *Previous Work on the Oxygen Electrode*

The first investigations on the oxygen electrode at

The second paper in a series of three, dealing with the acid base relationship in glass systems.

*Work sponsored by the Office of Naval Research under Contract N6 onr 269 Task Order 8, NR 032-264, The Pennsylvania State University, University Park, Pennsylvania. Mineral Industries Contribution No. 55-59.

elevated temperature are those carried out by F. Haber in 1906[4]. Haber's cell consisted of a glass tube separated into two sections by a thin glass plate in the middle. The glass plate was covered on both sides by a metal, platinum or gold, which served as electrodes. The glass plate was the electrolyte of the cell. At temperatures ranging from 330°C to 570°C, $H_2 - H_2O$ mixtures were passed over one electrode and $O_2 - H_2O$ mixtures over the other. The total cell reaction is the combination of H_2 and O_2 to form H_2O vapor, and the measured potentials were in fairly good agreement with data on the thermal dissociation of H_2O. The response of the EMF of the cell to the oxygen pressure over the oxygen electrode was also found to be in agreement with what may be calculated for an oxygen electrode. The same system was investigated later with a different cell construction by P. Csaki and A. Dietzel[5] using a sodium borate in the liquid state as electrolyte. A combination of an oxygen electrode and a metal electrode was used by B. A. Rose, G. J. Davis and H. J. T. Ellingham [6] in order to determine the free energy of formation of SnO_2 and PbO_2 in fused NaOH.

The investigations by H. Lux[1] are the first ones which directly aimed at an oxygen electrode in fused salts in order to determine "free oxygen ion concentration" or the basicity of a system. However, due to an unfavorable cell construction and an unfortunate choice of system, Lux did not obtain agreement between the observed and the calculated EMF of the cell.

An improved construction of a cell, containing two oxygen electrodes was made by H. Flood, T. Forland and K. Motzfeldt[7]. The oxygen electrodes consisted of platinum wires immersed in fused salt mixtures and oxygen gas was bubbled past the platinum wires. The fused salt mixtures were contained in two platinum crucibles, and the two half cells were connected by a liquid junction consisting of a porous MgO rod impregnated with fused salts. For systems containing sulfate, carbonate, and small amounts of oxide the EMF measured for the cell was in very good agreement with what one could calculate for a cell having oxygen electrodes. The measurements also indicated that the liquid junction potential was negligible for this system.

To check the reversibility of the oxygen electrode at elevated temperatures, H. Flood and T. Forland investigated the oxygen overpotential on platinum in different fused salts[8]. The experiments showed for different electrolytes that the overpotential could be neglected at low current densities at temperatures above 700°C.

R. Didtschenko and E. G. Roshow[9] attempted to measure "oxygen ion activity" in fused silicate. However, the authors do not discuss what the total potential-determining cell reaction is. The cell used was a concentration cell with transference containing two oxygen electrodes, one immersed in fused $PbO{\cdot}SiO_2$ and the other immersed in a fused $PbO{\cdot}SiO_2$ to which different oxides had been added. However, the fused silicates were contained in two platinum-lined porcelain crucibles, and the two crucibles were in contact with a fused glass. If the platinum lining was very dense, the EMF measured should be the potential developed between the two platinum linings. Thus, the EMF would be determined by the composition of the melt which was between the platinum lining and the porcelain crucible. The basis of the measurements is that the EMF is determined by the composition of the melt inside the platinum lining. How much the measurements are in error will thus depend on how dense the platinum lining is.

II. Experimental Procedure

The object of the present study was to develop a cell system which could be used to compare the basicity of glasses at temperatures in the annealing range and below this temperature.

The following cell was adopted for the measurement:

Ag (in air)/Glass I/Glass II/Ag (in air).

A schematic picture of the cell arrangement is shown in Figure 1. The two electrodes were made of silver foil.

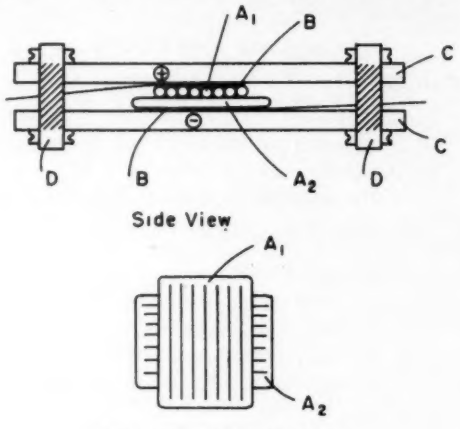

Fig. 1

The electrolyte consists of two rafts made of glass rods (diameter about 0.5 mm). The two rafts were made of glasses of different compositions. The reason why the electrolytes were made in the shape of rafts is that the drawing of glass rods offers a convenient way of obtaining pieces of glass where the surface is not contaminated by contact with other materials.

The equipment and techniques of melting the glasses and drawing the rods are the same as those described in detail by J. P. Poole[10]. Preparation of the rafts from the rods was made by first cutting the rods into pieces about 30 mm long. About ten of these rods were then aligned in the same plane in contact with one another, after which the ends were fused with a gas-oxygen torch. Before placing the rafts in the cell they were cleaned by rinsing with carbon tetrachloride and drying in air.

The silver electrodes were prepared by cutting two pieces of foil 10 mm x 30 mm x 0.06 mm from the same sheet of metal. These pieces were then cleaned with a paste prepared from Potter's flint and a detergent (calgonite) moistened with water, and rinsed with distilled water. The silver foil electrodes were then fused to platinum wires in a gas flame, and then boiled about five minutes in distilled water to render the surfaces as clean as possible. Following drying over a flame the electrodes were ready to be placed in the cell. New electrodes were prepared for each new cell.

As shown in Figure 1, two glass rafts of different compositions. (A_1, A_2) were brought into contact by

placing them crosswise, one on top of the other. A pair of silver foil electrodes (B) were pressed against the outside surfaces of a set of two glass rafts with two plates of quartz glass or window glass, C (3 mm in thickness), by means of screw clamps (D). The use of quartz glass or window glass gave no difference in the measured potential of the cell. This indicates that leakage of current through the clamping arrangement did not disturb the measurements significantly. During the above assembling procedure the cleaned glass rafts and silver electrodes were handled only with platinum tongs. The prepared cell was put into an electric furnace. The temperature was measured with a chromel-alumel thermocouple which was placed near the cell. The equilibrium temperature could be controlled within 10°C. The EMF was measured with a potentiometer using a vacuum tube voltmeter (Model 100, Electronic Designs, Inc., New York) as a zero instrument.

Preliminary measurements of the EMF produced by a cell constructed of glass rafts of different compositions indicated that the values obtained during the first heating at temperatures below 500°C were not always reproducible; that is, the EMF vs. temperature curves did not always agree when comparing cells of identical construction. However, it was found that if the temperature of the cell was held at 500°C for one hour, the EMF reached a constant value and this value was found to be the same for cells containing the same combination of glass electrolytes. Therefore, in the following measurements the EMF at about 500°C was measured after the cell was heated for 90 minutes at that temperature. The measurements of the potential differences below the temperature of 500°C. were made after the cell had first been heated to 500°C. The cell was held at each temperature until the EMF no longer changed before the EMF was recorded.

III. Experimental Results

1. *Cells with two glasses of the same composition.*

For a cell containing two glass rafts of identical composition, $Na_2O{\cdot}3SiO_2$, the EMF was zero over the temperature interval investigated, 350-500°C.

2. *Cells with glasses containing different amounts of silver oxide*

Different amounts of silver oxide (0.05, 0.01, and 0.005 wt. per cent) were introduced into a base glass of the composition $K_2O{\cdot}BaO{\cdot}4SiO_2$. Cells prepared from any combination of the above silver oxide-containing glasses had an EMF equal to zero over the temperature interval investigated, 300-500°C.

3. *Cells with glasses containing no alkali ions*

Due to a very high electrical resistance no EMF measurement could be carried out on a cell containing a combination of the two glasses, $MgO{\cdot}Al_2O_3{\cdot}4P_2O_5$ and $BaO{\cdot}Al_2O_3{\cdot}4P_2O_5$.

4. *Cells with glasses having different silica contents*

To investigate the effect of the SiO_2/Na_2O ratio on the EMF, cells were made having one glass of composition $Na_2O{\cdot}3SiO_2$ and one glass of composition $Na_2O{\cdot}xSiO_2$, where x was 2, 4, or 5. The electrode in contact with the glass having the highest SiO_2 content was always positive. The EMF as a function of the glass composition at different temperatures is shown in Figure 2 and the results are given in Table I.

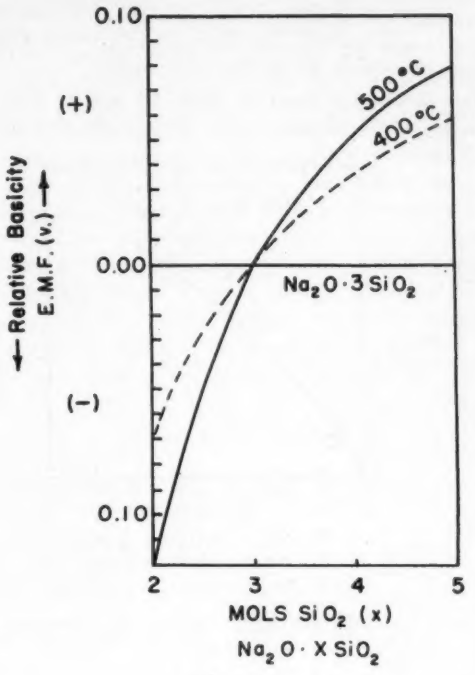

Fig. 2

TABLE I

Glass I	Glass II	Temp. °C	EMF (volt)
$Na_2O{\cdot}5SiO_2$	$Na_2O{\cdot}3SiO_2$	509	0.08
		472	0.07_5
		424	0.06_5
		315	0.04
$Na_2O{\cdot}4SiO_2$	$Na_2O{\cdot}3SiO_2$	520	0.05_5
		492	0.04_5
		368	0.03_5
		308	0.02
$Na_2O{\cdot}2SiO_2$	$Na_2O{\cdot}3SiO_2$	496	−0.12
		442	−0.09
		400	−0.07
		374	−0.06
		355	-0.05_5

5. *Cells with glasses containing magnesia and different amounts of silica*

As in the preceding series of cells, the electrode in contact with the glass highest in silica was positive. In contrast to the preceding series of cells, the EMF did not change measurably over the temperature range from 500°C. to 350°C. The results are given in Table II.

TABLE II

Glass I	Glass II	EMF (volt)
$Na_2O{\cdot}MgO{\cdot}4SiO_2$	$Na_2O{\cdot}MgO{\cdot}5SiO_2$	−0.03
$Na_2O{\cdot}MgO{\cdot}3SiO_2$	$Na_2O{\cdot}MgO{\cdot}5SiO_2$	−0.06

6. *Cells with glasses having different contents of alkaline earth oxides*

Cells were made containing one glass of the composition $Na_2O{\cdot}3SiO_2$ and one glass of the composition $(1\text{-}x)\,Na_2O{\cdot}xMgO{\cdot}3SiO_2$ or $(1\text{-}x)\,Na_2O{\cdot}xBaO{\cdot}3SiO_2$, where x was varied. The electrode in contact with the glasses containing Ba or Mg was positive.

The results are given in Table III and in Figure 3. Also the results of series 4 are given in the same plot.

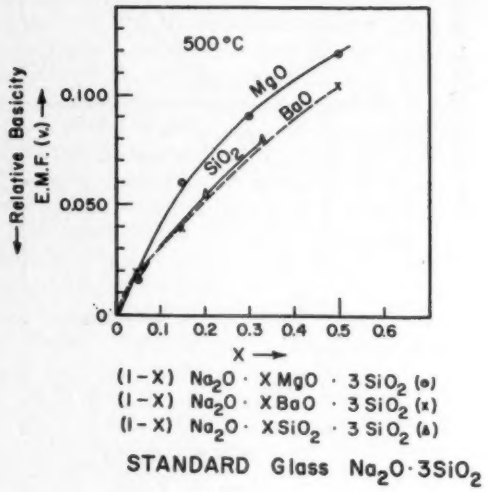

Fig. 3

TABLE III

Glass I	Glass II	Temp. °C.	EMF (volt)
19/20 $Na_2O{\cdot}$1/20 $MgO{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.01_5
		410	0.01_5
		335	0.01_3
17/20 $Na_2O{\cdot}$3/20 $MgO{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.06
		422	0.05_5
		338	0.03
14/20 $Na_2O{\cdot}$6/20 $MgO{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.09
		420	0.08
		340	0.05_5
10/20 $Na_2O{\cdot}$10/20 $MgO{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.12
		410	0.10_5
		337	0.09_5
19/20 $Na_2O{\cdot}$1/20 $BaO{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.02
		430	0.02
		350	0.02
17/20 $Na_2O{\cdot}$3/20 $BaO{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.04
		422	0.03_8
		310	0.02_5
10/20 $Na_2O{\cdot}$10/20 $BaO{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.10_5
		410	0.08
		340	0.04

7. *Cells with glasses containing different kinds of alkaline earth ions*

The EMF was measured for cells having one glass of composition $Na_2O{\cdot}MgO{\cdot}5SiO_2$ and one of composition $Na_2O{\cdot}RO{\cdot}5SiO_2$, where RO was CaO or BaO. The electrode in contact with the magnesia-containing glass was always positive. The results are given in Table IV.

TABLE IV

Glass I	Glass II	EMF (volt)
$Na_2O{\cdot}CaO{\cdot}5SiO_2$	$Na_2O{\cdot}MgO{\cdot}5SiO_2$	–0.03
$Na_2O{\cdot}BaO{\cdot}5SiO_2$	$Na_2O{\cdot}MgO{\cdot}5SiO_2$	–0.04

The EMF did not change measurably over the temperature interval investigated, 500°C. to 350°C.

8. *Cells with glasses containing mixtures of alkaline earth ions*

In this series of experiments potash glasses were used. The results are given in Table V.

TABLE V

Glass I	Glass II	EMF (volt)
$K_2O{\cdot}0.75MgO{\cdot}0.25BaO{\cdot}4SiO_2$	$K_2O{\cdot}MgO{\cdot}4SiO_2$	-0.01_5
$K_2O{\cdot}0.5MgO{\cdot}0.5BaO{\cdot}4SiO_2$	$K_2O{\cdot}MgO{\cdot}4SiO_2$	–0.03
$K_2O{\cdot}0.25MgO{\cdot}0.75BaO{\cdot}4SiO_2$	$K_2O{\cdot}MgO{\cdot}4SiO_2$	-0.04_5
$K_2O{\cdot}BaO{\cdot}4SiO_2$	$K_2O{\cdot}MgO{\cdot}4SiO_2$	–0.06

The electrode in contact with the glass of composition $K_2O{\cdot}MgO{\cdot}4SiO_2$ was positive. Temperature had no measurable effect on the EMF over the temperature range investigated, 500°C to 350°C.

9. *Cells with glasses containing mixtures of alkali ions*

The EMF was measured for cells having one glass of composition $Na_2O{\cdot}3SiO_2$ and one of composition $(1\text{-}x)\,Na_2O{\cdot}xK_2O{\cdot}3SiO_2$ where x had different values.

The results are given in Table VI and in Figure 4.

TABLE VI

Glass I	Glass II	Temp. °C.	EMF (volt)
$0.8Na_2O{\cdot}0.2K_2O{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.02_5
		394	0.02_5
		306	0.02
$0.5Na_2O{\cdot}0.5K_2O{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	0.04_5
		460	0.04
		431	0.04
		313	0.03
$0.3Na_2O{\cdot}0.7K_2O{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	516	0.02_5
		486	0.02_5
		332	0.02_5
		274	0.02
$0.1Na_2O{\cdot}0.9K_2O{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	315-500	0.0
$K_2O{\cdot}3SiO_2$	$Na_2O{\cdot}3SiO_2$	500	-0.01_5
		458	–0.01
		410	–0.01
		343	–0.01

The electrode in contact with "Glass I" was always positive, except for the cell containing the combination $Na_2O{\cdot}3SiO_2$ - $K_2O{\cdot}3SiO_2$.

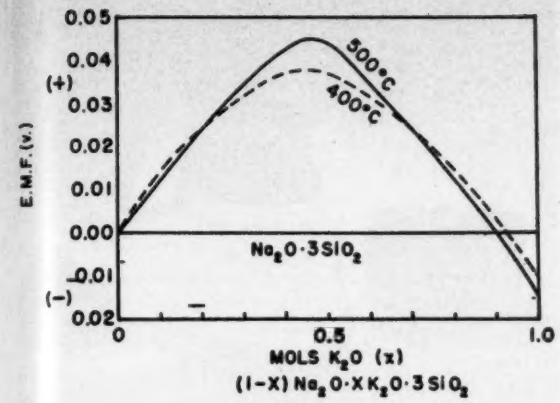

Fig. 4

IV. Discussion

a. *The Cell Reaction*

When silver metal is heated in contact with a glass in an oxygen-containing atmosphere (air), silver oxide will be formed in the glass in the region of the contact. In an alkali-containing glass only very small amounts of silver oxide can be introduced[11]. The reaction apparently takes place where the silver electrodes of the cell are in contact with the glass rafts. After a cell had first been heated to 500°C in air for some time, and then was heated in a reducing atmosphere, a yellow stain could be seen on the glass rafts in the region where they had been in contact with the silver electrodes, thus, indicating that silver oxide had dissolved in the glass. This indicates that the glass close to the electrode contains a small amount of silver ions. In the following discussion we will assume that the glass close to the electrode is saturated with silver oxide. This seems to be a reasonable assumption since the EMF was constant after heating for about one hour at 500°C. in air. The assumption is also supported by the experiments of series 2 which show that small amounts of Ag_2O introduced in the glass had no effect on the EMF measured. We will also assume that the amount of silver oxide dissolved in the glass is so small that its basicity is not changed to any significant amount.

If a small current is passed from left to right through the cell

$$O_2, Ag \,/\, Ag_2O \text{ in Glass I} : Ag_2O \text{ in Glass II} \,/\, Ag, O_2$$

silver ions in Glass II will be discharged at the electrode on the right side, and silver ions will be formed at the left electrode and enter Glass I. At the same time an equivalent amount of Na^+ ions will migrate from left to right if the glasses are soda glasses. As is shown in experiment 3, no EMF could be measured when the glasses did not contain alkali ions. The total reaction will thus be an exchange of Ag^+ ions by Na^+ ions in Glass II in the region of electrode contact, and an exchange of Na^+ ions by Ag^+ ions in Glass I at the other region of contact. The reaction may be written as:

$$Ag^+_{II} + Na^+_{I} = Ag^+_{I} + Na^+_{II}$$

This transfer of ions will be equivalent to the following transfer of oxides:

$$\tfrac{1}{2}\, Ag_2O_{II} + \tfrac{1}{2}\, Na_2O_{I} = \tfrac{1}{2}\, Ag_2O_{I} + \tfrac{1}{2}\, Na_2O_{II}$$

since the transfer of the oxygen ions back and forth in each glass does not give any change in the system. If there is no liquid junction potential, the EMF of the cell gives the change in free energy when Na_2O is transferred from Glass I to Glass II and, at the same time, Ag_2O is transferred from Glass II to Glass I. However, both glasses are assumed to be saturated with Ag_2O in the region close to the electrode. That means there is no change in free energy when Ag_2O is transferred from one side of the cell to the other. The EMF of the cell, therefore, gives the difference in free energy of Na_2O in the two glasses.

Concerning the liquid junction potential in fused salts or glasses there is not much information in the literature. L. H. F. Neubert and F. Sauerwald[12] have shown that for the cell

$$Pb/PbCl_2 : CdCl_2/Cd$$

the liquid junction potential is less than 4 mv.

From investigations on the concentration cell

(Pt) CO_2, O_2/Na_2CO_3 (c_1), Na_2SO_4 : Na_2CO_3 (c_2), Na_2SO_4/O_2, CO_2 (Pt)

(where c_1 and c_2 are Na_2CO_3 concentrations) for mixtures containing from 0.5 to 100 mol per cent Na_2CO_2, Flood, Forland and Motzfeldt[7] concluded that the liquid junction potential is small (probably less than 2 mv).

If for the concentration cell consisting of two soda glasses or of two potash glasses we also assume that the liquid junction potential is insignificant (less than 5 mv), we can write:

$$-E \cdot 2F = \Delta\bar{F}_{Na_2O} = \bar{F}_{Na_2O_{II}} - \bar{F}_{Na_2O_{I}} \qquad (1)$$

where E is the EMF of the cell, F is Faraday's number, and $\bar{F}_{Na_2O_{II}}$ and $\bar{F}_{Na_2O_{I}}$ are the partial free energies of Na_2O in the two glasses of a cell.

b. *The Basicity Concept*

Before discussing the experiments 4-9 we will first consider the basicity concept. In accordance with the previous discussion in the introduction, we define the basicity of a soda glass as the partial free energy of Na_2O in the glass. As a standard state we may use Na_2O in any of our glasses, e.g., $Na_2O \cdot 3SiO_2$, or we may choose pure fused Na_2O as the standard state. The first is most practical for this particular investigation; the second may be of more general importance.

In order to analyze the meaning of a basicity concept in relation to the partial free energy of one basic oxide component, e.g., Na_2O, in a system of oxides, one may consider the energy and the entropy changes in the system separately. For the types of reactions to be discussed here, the energy change of an ion has no meaning since the total electrode process involves the transfer of neutral molecules. However, in agreement with the description of

(*Continued on page* 399)

A.S.G.S. Holds First Symposium at Corning

A gift from Corning Glass Works, presented to all registered guests at the dinner commemorating the first symposium on the art of glassblowing.

THE FIRST SYMPOSIUM on the art of glassblowing sponsored by the American Scientific Glassblowers Society, resulted in an attendance unprecedented by any similar gathering. Glassblowers came from the far corners of the United States to register at the Baron Stuben Hotel in Corning, New York, for a two day meeting, June 8 and 9. The non-technical portion of the meeting was truly old home week for many. Friendships which were not united in twenty years were commonplace and provided a warm atmosphere to the proceedings which followed. Many brought their families along to enjoy the prearranged guided tour of the scenic Finger Lakes section while the technical sessions were in progress.

The meeting got under way on Friday, June 8, 1956 at 10 A.M. with a welcome address by O. M. Loytty. Chairman of the first day's session at which seven papers were presented was Robert D. Looms. The speakers and those presiding were all members of the Corning Glass Works, without whom, the meeting could not have been a success.

A change of pace from the sessions was provided in the form of a guided tour through "A" factory and pressware. This was an experience, and highlighted the day for the experimental glassblowers. Few had conceived the magnitude of the equipment required for high production glass forming.

The difficulties of discussing glass problems having theoretical explanations to an audience of practical scientific glassblowers are recognized. This reviewer hails the speakers' excellent presentation in conveying an understanding of the essential information contained in their papers.

A review of the papers follows:

"Annealing and Strain Measurements in Glass" by S. D. Burdick, assistant manager of the Works Control Laboratory. Mr. Burdick has done considerable work in the measurement of stress and the design of polariscopes.

The removal of detrimental stresses in glass by the use of open flames was discussed. It was pointed out that the conditions of annealing were dependent on (1) The rate of cooling (annealing cycle). (2) Thickness of the glass part. (3) Thermal expansion of the glass being annealed.

A definition of thermal expansion was given which indicated the change in length with a corresponding change in temperature. An appreciation of the minuteness of expansion numbers when expressed as 10^{-7}, was conveyed.

It was pointed out that while thin walled glass articles may be annealed in the open flame, the heavy walled pieces must be oven annealed. In practice oven annealing takes place at 10°-15°C. over the listed annealing temperature and the glass is held or soaked at this temperature for a period of 15 minutes. The annealing temperatures for the more commonly used glasses are given in the Corning Glass Works Bulletin B-83 which is available on request. The basic concepts of annealing to this point were clearly presented to the listeners so that all could mentally standardize on good annealing practice when fabricating glass apparatus. Mr. Burdick's scientifically sound information on annealing and stress in glass, continued with the following.

In commercial annealing of glassware the figure used in industry for allowable strain is 250 lbs/sq. in. The cooling rate is obtained from an equation and adjusted for thickness and expansion of the glass being annealed. Higher expansion glasses, such as lime glass, are cooled at a rate ⅓ slower than borosilicate glasses. Automatic oven controls may be employed for adjusting the cooling rate but it often suffices to simply turn off the oven even when heavy pieces are being annealed. Most commercial annealing ovens are sufficiently insulated to provide the necessary gradual reduction in temperature to prevent fracture.

The nature of stresses and the conditions which created them were reviewed.

A Mechanical Stress is released when the external force producing the strain is removed. Temporary stress disappears at room temperature (on cooling below the strain point temperature gradients exist in the glass and appear as temporary strain). Differential expansion stress results when materials having differences in their contraction rates are joined. These strains cannot be removed by annealing. This form of strain is common to many glass to metal seal combinations.

In multiple annealing operations, that is where annealing is necessary after each glass working operation, the preliminary annealing may be casual or equivalent to a residual stress of 500 lbs/sq. in. To assure safe results of the finished article the final anneal should not exceed 250 lbs/sq. in. The meaning of color in the polariscope has always been of major concern to the glassblower. Mr. Burdick discussed this subject and indicated some of the variables which produce erroneous qualitative and quantitative stress determinations.

He pointed out that an estimate of strain may be made

by color intensity but that this intensity is also dependent on the thickness of the glass.

Glasses of different compositions will show dissimilar colors for like conditions. As for example, when the same color is observed for a lime glass and a borosilicate glass, the stress in the soft glass could be 40 per cent greater than that in the hard glass. It was stated that color should not necessarily be cause for rejection, since the existing stress may not exceed 250 lbs/sq. in.

A mechanical test given for strain, was to scratch the glass surface with abrasive paper, then leave this abraided glass in water for a few hours, if the stress is very high the glass will break. This test has limitations because of its destructive nature.

Double tough glass, a condition of high surface compression was discussed. It is believed, that in Mr. Burdick's presentation, the foundation is established for an understanding of strains in glass. Scientific glassblowers should further their knowledge on this important subject by advanced reading. The following listed articles furnish a valuable reference:

Basic Principles of Glass Annealing—H. R. Lillie; THE GLASS INDUSTRY Vol. 31, No. 7, July 1950; Analysis of Strains and Stress in Glass—A. J. Monack and E. E. Beeton; THE GLASS INDUSTRY, I—Vol. 20, No. 4, April 1939; II—Vol. 20, No. 5, May 1939; III—Vol. 20, No. 6, June 1939; IV—Vol. 20, No. 7, July 1939.

The next paper, "Glass Strength" was presented by E. B. Shand, staff research engineer at Corning Glass Works. Mr. Shand is presently active in general product design, application of fibrous glass and engineering application of glass. The inherent strength of glass is seldom realized by its many users. With the increasing use of glass as a structural material, great importance has been placed on glass strength. This has been the subject of intensive investigation resulting in a number of articles published in recent years. Among Mr. Shand's contributions to the Literature was "Experimental Study of Fracture of Glass" published in two parts in the *Journal of the American Ceramic Society* during 1954 in which he comprehensively advanced the theory and understanding of glass strength.

In his well prepared talk, Mr. Shand gave the members of the glassblowers society some of the fundamentals of glass strength and the behavior of fractures.

Determination of the breaking strength of glass has always been difficult. Fractures are sensitive to the glass surface condition and the existing surface phenomena. Scratches will produce small "checks". These checks which are one or two mils deep, and very narrow for their depth, are not optically visible but manifestable after treatment in hydrofluoric acid. The stress concentration at these checks is very great. Glass often will not yield immediately when under stress, but the flaw will propagate, at a rate dependent on the stress, then the glass appears to fall instantaneously. The speed of crack propagation as affected by stress may be seen in the following illustration. A piece of glass will fracture in two or three seconds when a force of 10,000 lbs. per sq. inch is applied. The same piece of glass will take longer to fracture when force of 4500 lbs/sq. in. is applied.

The strength of glass is 25 per cent to 30 per cent higher at low temperature (–200°C.) than at room temperature. An increase in glass strength is exhibited also at high temperatures (strain point). The reason for this increase in strength at high temperatures was stated to be due to the rounding at the bottom of the little flaws. The strength of tempered glass is attributed to the surface compression holding together the little surface flaws. The glass strength increases with the amount of increase of surface compression.

The formula for glass wall thickness required for a given pressure is of interest to fabricators of glass apparatus. On the request of Dr. Glaser of Uniscience Inc., a member in the audience, Mr. Shand gave the following:

$$\frac{d\ P}{2 \times \text{wall thickness}} = \text{average stress on wall}$$

d = inside diameter of glass tube

P = Pressure (lbs/sq. in.)

It may be noted that the safe strength of glass is given at 1,000 lbs/sq. in. although the interior strength of glass may be one million lbs/sq. in.

"Photosensitive Glass," by S. D. Stookey, manager of fundamental chemical research, Corning Glass Works was next presented. Dr. Stookey's main fields of research have been in developing new glass compositions and processes, including opal and photosensitive glasses.

The development of "Photosensitive Glass", "Photoform" and "Photoceram", though in their infancy, can be acknowledged as the greatest contribution to glass decoration and fabrication since the advent of the blowpipe. Were it possible for this material to some day be available to experimental glassblowers, in the form of reworkable borosilicate tubing and rod, many of the limiting bounds of conventional glass fabrication would be removed.

Dr. Stookey discussed colored glasses, with emphasis on ruby glass and their color change with subsequent reheating. By using the photoforming technique, he told how a half million holes were accurately formed in a mask for color television use. By using a lithium silicate glass the exposed glass becomes 100,000 times more soluble in a 10 per cent hydrofluoric acid leaching solution.

New jewelry items have been produced from photosensitive glass. A half inch diameter cane of glass is pressed into the desired shape, a photograph or pattern is placed on the glass and exposed for from 2-24 minutes. The exposed glass parts are then baked for one hour at 650°C. to produce a permanent picture within the glass.

Those more seriously interested in this subject may refer to Dr. Stookey's article, "Photosensitive Glass"—S. D. Stookey, *Industrial and Engineering Chemistry*, Vol. 41, April 1949.

The next paper presented was "Glass to Metal Seals" by R. H. Dalton, research chemist. A few of Dr. Dalton's fields of research have been with rare elements, chain reactions in glass, gases in glass, glass composition and glass to metal seals.

The popular applications of glass to metal seals made the contents of this paper timely and important to those attending the meeting. The information on glass to metal seals was amply covered, the proper audience level was maintained and the necessary slides were shown which made this talk helpful and informative.

Dr. Dalton stated that the requirements of a good seal is its vacuum tightness and mechanical strength. Expan-

(*Continued on page* 405)

Recent Translations of Russian Papers of Interest to the Glass Industry

Wear Resistance of Metal Alloys in Glass Grinding

Grinding disks of various alloys were investigated by Ya. N. Malinochka (*Steklo i Keramika* (*Glass and Ceramics*) vol. **11**, No. 8, p. 14 (1954)). They were tested before and after heat treatment. The wear resistance is determined by the coefficient of abrasion KC, i.e. the ratio of the weight of abraded glass to the weight of the abraded metal. The greater the coefficient of abrasion the higher the wear resistance of the metal.

The depth of abrasion is determined by profilogram; h is the height of the hills after grinding and H_B the hardness of the disk material.

Table I gives the data for various chemical compositions of cast iron disks, Fe making up to 100 per cent.

TABLE I

Grinding disk	Per Cent Content					hardness		
	C	Si	Mn	P	S	H_B	KC	h
15-2	3.30	1.64	0.80	0.09	0.122	165	22.6	
12-1	3.63	1.75	0.63	0.08	0.116	121	16.3	0.76
10-1	3.65	1.22	0.40	0.08	0.065	111	11.2	0.76
20-1	3.70	1.40	0.75	0.10	0.024	159	15.0	
20M-3	3.70	1.40	0.75	0.10	0.024	137	5.1	
26-1	3.75	2.12	0.65	0.10	0.045	128	12.9	
26M-3	3.75	2.12	0.65	0.10	0.045	170	7.5	
23-1	3.60	2.58	0.75	0.08	0.060	121	12.6	0.75
27-1	3.34	3.70	0.64	0.07	0.047	99	10.3	0.74
18-1	3.51	1.55	1.14	0.08	0.058	159	22.7	0.72
14-2	3.40	1.78	0.70	0.09	0.03	170	10.0	
33-1	3.37	2.96	0.34	0.10	0.257	170	24.2	

The grinding disks marked with the letter M are cast in metal forms (all the others are cast in earthen forms) and show a marked decrease in wear resistance, e.g., 26-1 has a KC = 12.9, and 26 M-3 having the same chemical composition has a KC = 7.5.

The hardness of the cast iron grinding disks does not influence their wear resistance, e.g., the grinding disk 20 M-3 has a higher hardness than 12-1, but its wear resistance is three times as small.

As Table I shows, an increase in carbon content or in silicon content in the alloy reduces the wear resistance of the grinding disk. On the other hand the wear resistance of cast iron grinding disks is found to increase with the addition of more sulfur (grinding disk 14-2 with a sulfur content of 0.03 per cent has a KC = 10.0, and disk 33-1 with S = 0.257 per cent has a KC = 24.2), of phosphorus and of manganese (e.g., 10-1 has a Mn content of 0.4 per cent and the KC = 11.2, and 18-1 has Mn = 1.14 per cent and the KC increases to 22.7).

The height of the hills (h) in glass is independent of the composition of the grinding disks.

Microphotographs are taken of the surface of the grinding disks to discover its microstructure. Graphite plays an important part in the aggregates of the microstructure, and the globular form of the graphite enclosures is found to be the best suitable to obtain a grinding disk with the best wear resistance.

The wear resistance of steel grinding disks is high, and the harder the steel, the higher the wear resistance, e.g., a steel with a composition C 0.12 per cent, Si 0.08 per cent, Mn 0.53 per cent, P 0.020 per cent, S 0.064 per cent has a harness of H_B = 121 and KC = 23.1, and a steel grinding disk of the composition C 1.02 per cent, Si 0.28 per cent, Mn 0.36 per cent, P 0.02 per cent and S 0.075 per cent has a hardness of H_B = 229 and KC = 33.3.

A very high wear resistance is shown by a white cast iron grinding disk of the composition C 3.4 per cent, Si 1.88 per cent, Mn 1.06 per cent, P 0.116 per cent, S 0.142 per cent, its hardness is H_B = 555 and KC is 36.9, but as it contained a small amount of cementite, scratch marks appeared on the grinding disk.

Quenching of cast iron grinding disks reduces their wear resistance.

Annealing increases the wear resistance when kept in the temperature range of 400-500°C., at higher temperatures the wear resistance decreases, and at 600-650°C. the wear resistance equals again that of the sample before any heat treatment.

Normalization gave the best results in wear resistance of all heat treated grinding disks, but as it required a special heating of the cast iron, it had to be abandoned, and instead a rapid cooling from 900-850°C. is recommended.

According to the above findings a cast iron grinding disk is as good as a steel grinding disk, if the former is properly heat treated and if it has the right composition, and will be preferred for glass grinding.

After taking into consideration all the above findings, the following composition for a cast iron grinding disk can be recommended: C 3.2-3.4 per cent, Mn 0.7-0.9 per cent, P 0.3-0.4 per cent, Si 1.5-1.7 per cent, S up to 0.2-0.3 per cent.

Aluminum grinding disks were tried out to replace plastic grinding disks. The smallest height of hills is achieved, when an alloy of Al 93.6 per cent, Zn 4.85 per cent, Fe 0.78 per cent, Si 0.28 per cent, Cu 0.1 per cent is used; this h was 0.46 microns, i.e. not much greater than that obtained with a plastic grinding disk. The KC for this alloy is 3.1, i.e. better than for many plastic disks. The hardness of the disk is of no importance to the wear resistance in this case, either.

No scratching of the glass was observed with any of the grinding disks under investigation, except the white cast-iron disk.

Continuous Production of Corrugated Glass

A new important building material is corrugated glass. It has a high mechanical strength and a sufficient light

transmittance. It can be used for street lamps, glass roofs, interior wall dividers, and garden walls.

A. Kh. Miller and N. N. Buneev describe in *Steklo i Keramika* (*Glass and Ceramics*) Vol. **11**, No. 5, p. 15 (1954) a continuous roller for the production of corrugated glass.

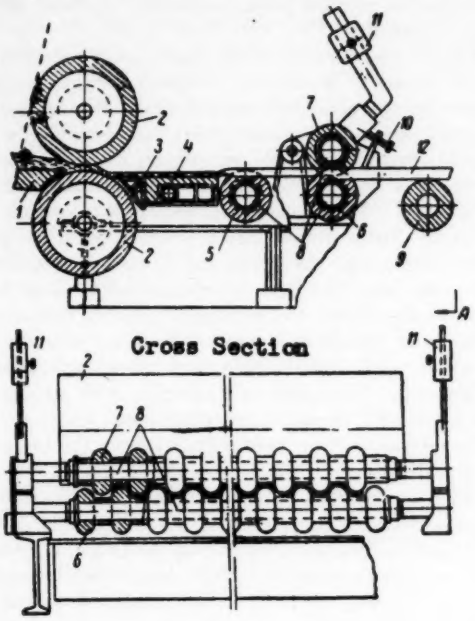

Fig. 1

The working end of the glass tank is separated from the melting end by a narrow throat 1.2 meter deep and has an area of 6.2 sq. meter. In the wall opposite to the throat, 90 mm below the melt surface is a horizontal slit of 1400 by 150 mm through which molten glass flows on an incline (1 in fig. 1) and to the rollers (2). After having been flattened, the glass sheet (3), still soft and flexible, moves along the cooling table (4) and then to the corrugating device (5), (6) and (7) which consists of separate rings set on axles (8) and turning because of the friction with glass sheet, which is pulled by the rollers (9) of the lehr, turned at a constant rate by a D.C. motor. Thus the glass sheet is really pulled between the rings of the corrugating device.

The height of the glass wave is set by the stop (10) which regulates active counterweight pressure. (11).

In continuous work at a rate of glass movement of 100 to 120 meter per hour a corrugated glass of 5-6 mm thickness (with metal screen or without metal screen) of a satisfactory quality is obtained.

After having passed the corrugating rings the corrugated glass (12) is moved to the lehr for annealing.

For cutting corrugated glass, the device shown in Fig. 2 is used. The glass sheet (1) is carried along by rollers (2) between electric heaters (3 and 4), lifted by the levers (5). As soon as the corrugated glass reaches the rest (6), the measuring rod (7) with carriage starts to move and the cable (8) attached with one end to the carriage and wound on a reel (9), starts to unwind and the cable (10) by the action of the counter weight (11) starts to wind on the reel (12). At the same moment two electrodes (13) and (14) are lowered by the plates (15) onto the glass. The plates slip off the support (16). (The dotted lines show the position when the electrodes are raised, the solid lines show the heating of the corrugated glass sheet.) While in motion the glass sheet is heated and is then cut by cool air. The carriage continues moving on the incline (17), the rollers (18) together with the electric heaters are raised and the lock (19) lowers and prevents the electric heaters to fall back on the glass when the carriage returns.

Now the rest (6) is raised from the border of the sheet, freeing the measuring rod (7), at the same time the counter weight (11) is lowered, the cable (10) unwinds and pulls the carriage into the initial position. As soon as the carriage comes into the original position, the clamp (20) locking the rest (6) is lowered and remains lowered until the glass sheet reaches the rest. The cut off glass sheet is taken off the conveyor belt and stored.

An important feature of this process is that the glass is not only rolled but is also stretched, as the rollers of the lehr turn 5-10 per cent faster than the rollers of the corrugating device.

Zinc Sulfate and Iron Sulfate in Glass Polishing

A. G. Minakov et al, and A. S. Totesh report in *Steklo i Keramika* (*Glass and Ceramics*) Vol. **11**, No. 8, p. 23 and p. 26 (1954) on the improvement of iron oxide suspension used in the polishing of glass, by adding to the suspension either a solution of zinc sulfate ($ZnSO_4 \cdot 7H_2O$) or of iron sulfate.

For their experiments they used a coarse felt polisher.

When Fourcault glass was used, the amount of glass abraded increased by 25 per cent when polished with an iron oxide suspension in a solution of 2-16 g./liter of zinc sulfate.

A borosilicate glass treated in the same way showed an increase in the amount of glass abraded by 13 per cent and a mirror glass 15 per cent as compared to polishing using iron oxide suspension in water.

Ferrous sulfate raised the rate of abrasion by about 25 per cent when its concentration in the suspension was 4 to 28 g./liter.

A. S. Totesh showed that the pressure of the polisher is of great importance. At 250 g./cm² pressure when polishing with rouge in a zinc sulfate solution, the glass abrasion was 0.55 grams in 30 minutes; at a pressure of 200 g./cm² the glass abrasion was 0.38 grams in 30 min. and at 90 g./cm² it was only 0.21 grams in 30 min.

The same relation existed when iron oxide was suspended in a ferrous sulfate solution at a concentration of 7.6 g./liter. At a pressure of the polisher of 200 g./cm² the amount of glass abraded was 0.33 g./30 min. and at a pressure of 90 g./cm² it was 0.17 g./30 min.

At a pressure of the polisher of 90 g./cm² the temperature of the glass surface was 35°C. at 200 g./cm² it rose to 50°C. Thus with an increase of temperature (up to 85°C.) a higher rate of glass abrasion resulted. However, at higher temperatures the amount of iron oxide suspension needed for best results was greater.

When the same experiments were repeated on industrial scale, an addition of zinc sulfate solution to iron

(*continued on page* 414)

Inventions and Inventors

Annealing and Tempering

Treating Glass Disc to Resist Breakage. Fig. 1. Patent No. 2,730,840. Filed September 28, 1949. Issued January 17, 1956. One sheet of drawings. Assigned to General Railway Signal Company by Frank S. Craig.

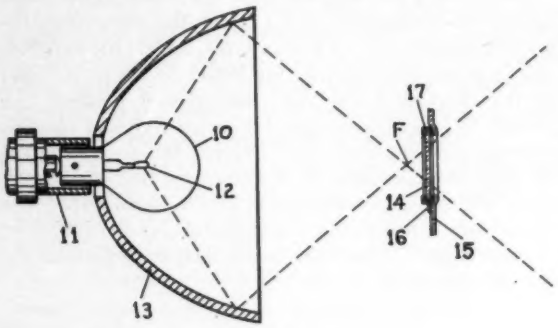

Fig. 1.

This invention relates to ring mounted color glass disc for railway signals.

According to Fig. 1, a searchlight signal comprises a light system having a lamp 10 secured in a lamp socket 11 and disposed with its filament 12, at the focal point of a suitable parabolic reflector 13. The reflector 13 focuses the light emitted by the lamp 10 at point F. Slightly displaced from this focal point F is a color disc 14, secured in a disc operating sector 15 by suitable spring clips 16, bearing against a ring 17, in which the color glass disc 14 is secured. It is generally provided that three such color glass discs red, yellow and green respectively are disposed adjoining respective openings in this operating sector 15, so that the electromagnetic actuation of the sector 15, about a pivot point (not shown), is effective to select the aspect to be displayed by the signal, according to which one of the three color glass discs is disposed within the beam of light emitted by the light system near the focal point F.

After a color glass disc has been cut to a desired diameter from this material, a diametric crack 18 (not shown) is formed therein, by any suitable means, such as a hot wire; then the disc is dropped within a flanged ring 17 of soft material such as aluminum or copper.

After the ring mounted color glass disc 14 has been annealed in the furnace at 1200°F., for two and one-half minutes, it is removed from the furnace and allowed to cool in still air at room temperature, thus providing to Corning Glass Works by S. D. Stookey.

There were 3 claims and 10 references cited in this patent.

Photograph on Glass. Patent No. 2,732,298. Filed Dec. 5, 1952. Issued Jan. 24, 1956. No drawings. Assigned to Corning Glass Works by S. D. Stookey.

This invention relates to the production in glass and in glazes of permanent two-dimensional photographic images suitable for use as reticles and scales, microphotographic records, projection slides, portraits, decorations and the like.

There is first formed on the surface of a silicate glass, by conventional procedure, a chemically fixed, photographic image composed of colloidal silver or a compound of silver. The glass, together with the image, is then heated, either in air alone or with an additional oxidizing agent or medium present, at a temperature between about 125°C. below the strain point of the glass and just below its softening point for a time sufficient to oxidize and ionize the silver and to cause migration of silver ions into the glass in exchange for alkali metal ions therein. While the minimum and maximum temperatures at which the reactions can occur vary with the strain point and the softening point respectively of the glass, the practicable temperatures will not be less than about 400°C. nor more than about 650°C.

The migrated silver sufficiently changes the refractive index of the glass to produce a visible image, which is usually of a yellowish to brownish color due to spontaneous conversion or reduction of a small portion of the silver ions in the glass to metallic particles. If desired, more or less complete reduction and intensification of the color to dark amber or brown can be accomplished by heating the glass in a reducing medium or atmosphere containing a reducing gas such as hydrogen, carbon monoxide or methane.

In glasses of the borosilicate type, maximum conversion or reduction of the silver ions in the glass to metallic particles, for reasons not known, occurs spontaneously during the ion exchange and the full color of the image in the glass is thereupon developed.

There were 16 claims and the following references cited in this patent: 112,703, Goodes, Mar. 14, 1871; 719,197, Crabtree, Jan. 27, 1903; 2,472,128, Staehle, June 7, 1949; 2,515,275, Stookey, July 18, 1950, and 2,515,936, Armistead, July 18, 1950.

Adhering Gold To A Non-Porous Ceramic Surface. Patent No. 2,733,167. Filed May 8, 1953. Issued January 31, 1956. No drawings. Assigned to Corning Glass Works by S. D. Stookey.

This invention relates to the art of decorating or metallizing a non-porous ceramic surface, particularly a vitreous ceramic surface, by forming a thin adherent gold film on such surface. It is customary to employ preparations known as liquid bright gold compositions, in the formation of such gold films; the present invention is particularly directed to improved compositions of this type.

According to this invention, a compatible copper compound is included as a flux in such base material, in such an amount that the ratio of the respective Au and Cu weight-equivalents of the gold and copper compounds is from about 8/1 to about 30/1. If the amount of the copper compound is appreciably less than indicated by such ratio range, no effective improvement in alkali resistance is imparted to the gold film. On the

other hand, if the copper compound is present in too large an amount, the gold film tends to have a dull brownish color, rather than the desired bright mirror finish. Liquid bright gold preparations generally contain a gold compound in an amount equivalent to about 10-12 Au by weight. It is found that it is generally desirable to utilize the copper compound in an amount equivalent to about 0.4-1.3 per cent Cu by weight. Desirably a smaller amount, rather than a larger amount, of copper is employed.

Any inorganic or organic compound of copper which is compatible with the liquid bright gold preparation and which does not leave an undesirable residue on firing may be used. Cupric Chloride dihydrate, $CuCl_2.2H_2O$, is particularly satisfactory as it is readily available, is easily handled and compatible with liquid bright gold preparations. Anhydrous cupric chloride, copper oleate and other compatible copper compounds may also be used. Organic compounds, such as copper resinate and copper stearate, which have such high organic contents that they leave a carbonaceous residue on firing, are generally unsatisfactory.

There were 5 claims and the following reference was cited in this patent: 2,490,399, Ballard, Dec. 6, 1949.

Feeding and Forming

Press-Molding Glass Articles. Patent No. 2,732,665. Filed Feb. 26, 1953. Issued Jan. 31, 1956. Four sheets drawings; none reproduced. Assigned Jeannette Glass Co. by R. P. Cassell.

This invention relates to apparatus for down-pressing glassware and particularly for the simple pressing of glass tumblers.

The invention in structure and procedure primarily consists in making an intermittent-action-turntable glass pressing apparatus. The number of molds carried by the turntable and the means for imparting intermittent motion to the turntable are so related that each impulse imparted to the turntable moves it through a plurality of mold spaces, that is, through a distance which is an apportioned multiple of the distance between the centers of adjacent molds. Also of importance in the structural organization of the apparatus, the arrangement and action of the pressing plungers permits simultaneous but independent pressing to produce simultaneously two perfect hollow glass articles. The preferred spacing of the pressing plungers, three mold-spaces apart, accommodates to the positioning of fluid pressure cylinders of adequate diameter for the pressing plungers to act independently and to the described "leapfrog" presentation of molds for feeding and to pressing. The above-noted simultaneous production of two perfect hollow glass articles, such as tumblers, is possible because of the independent action of the two pressing cylinders, which permit them to be independently adjusted to difference in the gobs which have been delivered to the two presented molds. The "leapfrog" method of operating glass-pressing apparatus gives a simple but striking answer to the problems of multiple pressing by providing a satisfactory procedure which it is possible to follow in a simple apparatus comprising an intermittently propelled turntable.

There were 8 claims and the following reference cited: 2,357,501, Carnahan, Sept. 5, 1944.

Glass Compositions

Lead Glass Composition. Patent No. 2,736,714. Filed January 4, 1952. Issued February 28, 1956. No drawings. Assigned to Owens-Corning Fiberglas Corp., by Ralph L. Tiede.

Fibrous lead glass has applications in many fields, including the medical field. A chief use in this case is a fabric prepared from lead glass fibers and manufactured into a garment such as a gown or apron which is worn by physicians and radiologists as a radiation shield against penetrating X-rays or Roentgen rays.

An improved glass composition can be realized from the standpoint of forming products therefrom, especially glass fibers, if the liquidus temperature can be lowered, or the temperature of the operating viscosity raised, or both. In such a case, the increased difference or "spread" between the liquidus temperature and the temperature of the operating viscosity greatly diminishes the dangers of devitrification.

Desirable lead glasses for fiber drawing have been formed within the following composition limits:

	Weight per cent
SiO_2	30.0–37.0
PbO	57.0–65.0
Al_2O_3	2.00– 5.0
Alkali oxide	1.5– 7.0

The alkali oxide may be an oxide of an alkali metal found in group I of Mendeleeff's Periodic Table. The alkali oxides usually employed are sodium oxide and potassium oxide.

There were 3 claims and the following references cited in this patent: 1,943,051, Berger, Jan. 9, 1934; 2,431,980, Armistead, Dec. 2, 1947; 2,528,634, Armistead, Nov. 7, 1950; 2,623,549, Archer, Dec. 30, 1952, and 2,537, Great Britain, of 1855.

Thermoplastic Colors to Objects. Patent No. 2,731,912. Filed March 23, 1950. Issued January 24, 1956. Two pages of drawings; none reproduced. Assigned to The O. Hommel Co. by Regis Welsh.

This invention relates to a method and apparatus for screening thermoplastic or resinous coloring compounds onto glass or ceramic ware and keeping it in a proper fluid condition during application.

In the process of decorating objects such as ceramic ware by screening, a fine mesh screen is used. Areas of this screen are masked or coated over and the uncoated or unmasked areas provide a pattern of the desired outline or contour through which coloring material is forced by movement of a squeegee over the screen.

Means are provided for heating a body of thermoplastic or resinous color compound resting on a screen, so that the color may be constantly maintained, at just the right fluidity, for ready flow through the interstices of the screen. The screen is heated by electrical resistance, the heat generated in the screen being thus immediately available for heating the color layer thereon. Upon contact with the ware, which is relatively cold, the thermoplastic material quickly hardens so that the object can be applied directly over a preceding one and several colors can be applied in immediate succession. A silk screen may be used in place of the wire screen and in this case an overlying series of wires are used to heat the thermoplastic.

The thermoplastic colors are normally hard solids which may be liquified by heat. The melting points of the different thermoplastic colors vary and therefore the temperature that must be used in maintaining the necessary viscosity of the fluid thermoplastic will depend upon the viscosity characteristics of the different thermoplastics.

There were 7 claims and the following references were cited in this patent: 1,035,614, Low et al., Aug. 13, 1912; 1,961,829, Rutoskie et al., June 5, 1934; 2,165,970, Jaspers, July 11, 1939; 2,239,619, Murgatroyd, Apr. 22, 1941; 2,339,423, Pollard, Jan. 18, 1944, and 2,510,999, Oldofredi, June 13, 1950.

Glass Composition. Patent No. 2,733,158. Filed November 7, 1952. Issued Jan. 31, 1956. No drawings. Assigned Owens-Corning Fiberglas Corp. by R. L. Tiede.

It has been found that when glass twines, cords, strands or fabrics are used to reinforce flexible products such as those of plasticized resinous materials or rubbery materials, the individual fibers of glass in the reinforcing material abrade upon one another causing failure within the reinforcing fibers and subsequent failures in the finished products. Likewise certain articles of fibrous glass which are subjected to repeated flexing and bending such as curtain materials and the like may show wear or fail completely.

It has been discovered that glass compositions containing copper oxide have very high abrasion resistance and flex resistance in addition to the other requisite properties desirable when forming fibrous materials. Glass compositions illustrative of this invention are as follows, portions being expressed in weight per cent:

SiO_2	50.0–60.0
Al_2O_3	4.0–17.0
B_2O_3	2.0–13.0
CaO	3.0–15.0
Na_2O	0.2– 3.5
CuO	5.0–15.0

There were four claims and the following references cited in this patent: 1,939,329, White, Dec. 12, 1933; 2,339,928, Hood, Jan. 25, 1944; 2,394,493, Schoenlaub, Feb. 5, 1946, and 2,685,526, Labino, Aug. 3, 1954.

Glass and Wool Fiber

Synthetic Fiber and Process of Coating. Patent No. 2,731,367. Filed Dec. 20, 1951. Issued Jan. 17, 1956. No drawings. Assigned Owens-Corning Fiberglas Corp. by Remus F. Caroselli.

This invention relates to the treatment of fibers and fabrics produced therefrom in a manner to render the fabrics and fibers substantially completely and permanently free of static charges.

Bare heat cleaned glass fibers or glass fibers in forming may be treated by application of an aqueous composition containing 0.8 per cent by weight potassium isobutyl polysiloxanolate. When applied in forming, the composition may be wiped onto the strands. To render the antistatic treatment more permanent, it has been found desirable to heat the treated glass fibers to a temperature within the range of 300-350°F. for 5-30 minutes. After drying, the treated fibers are acidulated with a 5 per cent solution of hydrochloric acid applied to the glass fiber surfaces in a similar manner as the polysiloxanolate composition. Application of the acidulating medium is followed by drying and then the dried fibers are preferably rinsed with water to remove any residual salts which might have been formed.

There were 9 claims and the following references cited in this patent: 2,354,110, Ford et al., July 18, 1944; 2,392,805, Biefeld, Jan. 15, 1946; 2,492,498, Pedersen, Dec. 22, 1949; 2,507,200, Elliott et al., May 9, 1950; 2,587,636, MacMullen, March 4, 1952; 2,630,620, Rand, March 10, 1953, and 2,635,060, Cheronis et al., Apr. 14, 1953.

Glass Fiber Filament Strand and Method of Manufacturing Glass Fabric. Patent No. 2,712,509. Filed August 17, 1951. Issued July 5, 1955. No drawings. Assigned to Owens-Corning Fiberglas Corporation by Lawrence P. Biefeld.

This invention relates to the treatment of glass fibers and it relates more particularly to the application of a new and improved size to glass fiber filaments to improve the physical and electrical properties of strands, yarns and fabrics formed thereof and to increase their chemical and heat resistance.

Glass fibers in filament, strand, yarn or textile form have been successfully coated with polytetrafluoroethylene resinous material to produce a new and improved glass fiber product, by treatment of the fibers in filament form, with a dispersion of polytetrafluoroethylene resinous material in particle form, and a fugitive binder which functions to hold the filaments together in strand or yarn form. The strands are capable of removal from the forming package onto which it is formed, twisted into cones or multiple wound upon new packages for braiding onto wire or the like, or woven into tapes and cloth, or formed into other fibrous fabrics. The fugitive binder may be made of wax, paraffin, gelatin, starch, glucose and other binder substances, alone or in various combinations. When in position of use, the fiber sized with the polytetrafluoroethylene particles and fugitive binder are heated to a temperature in excess of that necessary to effect coalescence of the particles of polytetrafluoroethylene to form a substantially uniform coating thereof on the glass fiber surfaces. At the temperature of coalescence, the fugitive binder is substantially disposed of such that the polytetrafluoroethylene coating is relied upon thereafter for bonding the filaments in their bundle arrangement.

An example of a successful composition is as follows:

Composition A

5 per cent by weight polytetrafluoroethylene
94.5 per cent by weight water
0.5 per cent by weight wetting agent such as sodium oleyl methyl laurate

Composition B

10 per cent by weight paraffin
89.8 per cent by weight water
0.2 per cent by weight emulsifying agent

Composition A is applied to the glass fiber filaments in forming, as by a roll applicator, and Composition B is applied onto the glass fiber filaments after the first roll applicator by a wiper pad or the like.

The patent contains eleven claims and the following references were cited: 2,272,588, Simison, Feb. 10, 1942; 2,392,805, Biefeld, Jan. 15, 1946; 2,484,483, Berry, Oct.

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Research Digest

The Colors of Platinum, Palladium and Rhodium in Simple Glasses

The use of the platinum metals and their alloys in the melting and manufacturing processes in the glass industry during the last fifteen years has shown a tremendous increase. Their chemical inertness to most molten glasses, and their refractory nature in particular, have made it possible to produce glasses of unprecedented high quality. The optical-glass industries were among the first to explore the possibilities of the use of platinum. Their success prompted other manufacturers of glass to adopt this precious metal for a number of purposes. Linings of glass tanks, stirrers, dies for drawing glass fibers, and protective coatings for electrodes used in electrical glass melting are a few applications.

There have been instances, however, where the platinum metals have not been completely chemically inert to the action of molten glass. The optical-glass manufacturers have encountered a reddish color in some high-barium and lead-containing glasses melted in platinum-rhodium crucibles. This color has been attributed to submicroscopic crystals of rhodium and is an analogue, so to speak, of the well-known gold-ruby. Gold-ruby glass owes its color to colloidal crystals of gold dispersed in the glass.

There have been other instances where glasses have turned gray during the course of melting when in contact with platinum. This color has been attributed to particles of platinum of microscopic size dispersed in the melt. During the course of electrolytic oxidation and reducton of glass, using platinum electrodes, certain phosphate glasses were colored yellow by platinum from the electrodes.

These observations reveal that the platinum metals are not so inert to the action of molten glasses as originally believed. If molten glasses will react with these metals, it becomes important, then, to know the effects on the finished glass, particularly on the color. It would be especially desirable to know whether these metals are retained in the ionic, atomic, or crystalline states in glasses of different compositions.

As a start in this direction, Rindone and Rhoads report in the May 1956 issue of the *Journal of the American Ceramic Society* on the results of a study of the colors produced by platinum, palladium, and rhodium in simple alkali borate, phosphate, and silicate glasses.

The metals platinum, palladium and rhodium were introduced into the glass batches as aqueous solutions of the chlorides: $PtCl_4.2HCl.6H_2O$, $PdCl_2.2H_2O$, and $RhCl_3$. The silicate glasses were prepared from c.p. alkali carbonates and potter's flint, the borates from c.p. boric acid and c.p. alkali carbonates and the phosphates from alkali metaphosphates. Batches were prepared to yield 75 gm. of glass. The solutions were added to the mixed batches and after drying at 100°C. the batches were mixed again. Melting was done in kyanite crucibles in an electric furnace using silicon carbide elements. The approximate temperatures were: 1450°C. for the silicates, 900°C. for the borates, and 800°C. for the phosphates.

The glasses were cast into plates ½ by 2 in. and were pressed to a thickness of 2.0 to 2.0 mm. Plates ⅜ in. thick also were cast. Annealing was performed by slow cooling for 15 hours from 450°C. for the silicates, 350°C. for the borates, and 250°C. for the phosphates.

The color and the degree of turbidity or crystallization of the samples were determined visually and the transmittances in the range 400 to 740mμ were measured on a General Electric recording spectrophotometer.

In the alkali silicate and borate glasses studied, platinum produces either transparent gray or turbid gray colors. The phosphate glasses show yellow, orange, and brown colors in addition to gray.

The nature of the alkali present in the silicate glasses seems to influence the amount of platinum that can be introduced, before gray colors are produced, for example, potash glasses can retain five times more than the lithia glasses and the soda glasses twice as much as the lithia glasses. This clear cut relationship is not observed in the borate glasses. In the phosphate glasses, low concentrations of platinum produce gray colors whereas larger amounts produce yellow or orange colors. At still higher concentrations (up to 0.4 per cent) some platinum crystallizes in the form of hexagonal plates of macroscopic dimensions and produces beautiful adventurines. In a sodium metaphosphate series of glasses oxidizing conditions resulted in yellow colors, while reducing conditions resulted in gray colors.

Palladium produces primarily yellow to brown colors. It also can be detected in the silicate and borate glasses in lower concentrations than platinum.

The colors produced by rhodium in the silicates, borates, and phosphates are yellow, peach, and orange to amber as well as gray.

Metals can exist in glasses in several different states. They can exist as ions which give color, as atoms which produce no color but which may fluoresce, and as groups of atoms which produce colors that vary with the size of the groups.

The behavior of copper may be cited as an example. In a silicate melt equilibrium is established between Cu^{2+}, Cu^{+} and elemental Cu°. The presence of both Cu^{2+} and Cu^{+} produces colors ranging from blue to green, depending on the base glass composition. Copper atoms, however, are colorless. Upon aggregating to form copper crystals of colloidal dimensions the well-known copper-ruby glass is formed. Further aggregation to larger sizes causes muddy brown to gray colors.

In the present investigation the colors obtained with platinum, palladium, and rhodium in alkali silicate borate, and phosphate glasses, other than the grays, were not changed by heat-treatment. It is believed, therefore, that these are ionic colors.

The most common valence states in which platinum

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Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during April 1956 was as follows: *Flat Glass:* A preliminary figure of 30,500 for April indicates an increase of 2 per cent from the adjusted 29,900 reported for March. *Glass and Glassware, Pressed and Blown:* An increase of 1.1 per cent is shown by the preliminary April figure of 82,900 when compared with March adjusted 82,000. *Glass Products Made of Purchased Glass:* The preliminary 15,800 indicates an increase of 0.6 per cent from the previous month's 15,700.

Payrolls in the glass industry during April 1956 were as follows: *Flat Glass:* An increase of 1.9 per cent is shown in the preliminary $14,523,795 when compared with March adjusted $14,254,825. *Glass and Glassware, Pressed and Blown:* An increase of 0.6 per cent is shown in the preliminary $28,239,056 reported for April when compared with the previous month's adjusted $28,067,780. *Glass Products Made of Purchased Glass:* A preliminary figure of $4,575,680 was reported for April. This is a decrease of 0.1 per cent compared with the adjusted March figure of $4,580,004.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

Narrow Neck Containers

	May, 1956
Foods	1,155,000
Medicinal and Health Supplies	1,318,000
Chemical, Household and Industrial	819,000
Toiletries and Cosmetics	796,000
Beverage, Returnable	821,000
Beverage, Non-returnable	115,000
Beer, Returnable	367,000
Beer, Non-returnable	816,000
Liquor	790,000
Wine	372,000
Sub-total (Narrow)	7,369,000

Wide Mouth Containers

Food	°3,368,000
Medicinal and Health Supplies	450,000
Chemical, Household and Industrial	167,000
Toiletries and Cosmetics	223,000
Packer's Tumblers	128,000
Dairy Products	182,000
Sub-total (Wide)	4,518,000
Total Domestic	11,887,000
Export Shipments	251,000
TOTAL SHIPMENTS	12,138,000

° This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production May, 1956	Stocks May, 1956
Foods; Medicinal and Health Supplies; Chemicals, Household and Industrial: Toiletries and Cosmetics	Narrow Neck	4,537,000	5,424,000
	Wide Mouth	°4,106,000	5,094,000
Beverage, Returnable		924,000	1,518,000
Beverage, Non-returnable		131,000	217,000
Beer, Returnable		340,000	421,000
Beer, Non-returnable		714,000	805,000
Liquor		911,000	1,124,000
Wine		411,000	533,000
Packer's Tumblers		147,000	174,000
Dairy Products		172,000	363,000
TOTAL		12,393,000	15,673,000

° This figure includes Fruit Jars and Jelly Glasses.

Glass container production, based on figures released by the Bureau of Census, was 12,393,000 gross during May, 1956. This represents an increase of 3.4 per cent from the previous month's production of 11,985,000 gross. During May, 1955, glass container production was 11,758,000 gross or 5.1 per cent under May, this year. At the end of the first five months of 1956, glass container manufacturers have produced a total of 58,470,000 gross. This is 7.1 per cent over the 54,640,000 gross produced during the corresponding 1955 period.

Shipments of glass containers during May 1956 increased 12 per cent to reach 12,138,000 gross. This is an increase from April, 1956 shipments which were 10,839,000 gross. Shipments during May, 1955 were 11,856,000 gross or 2.5 per cent under May, 1956. At the end of the first five months of 1956, shipments have reached a total of 55,133,000 gross, which is 4.5 per cent over the 52,725,000 gross shipped during the corresponding period last year.

Stocks on hand at the end of May, 1956 were 15,673,000 gross. This is 0.8 per cent above the 15,549,000 gross on hand at the end of April, 1956 and 9.4 per cent higher than the 14,331,000 gross on hand at the end of May, 1955.

Automatic tumbler production during April 1956 was 4,760,949 dozen. This is a loss of 7.3 per cent against the March, 1956 production, which was 5,136,293 dozen.

Production during April, 1955 was 5,513,302 dozen. Shipments during April, 1956 dropped to 4,843,325 dozen. This is 5.3 per cent lower than the 5,114,034 dozen shipped in March, 1956.

Shipments during the first four months of 1956 were 19,084,594 dozen. During the same period in 1955, shipments were 20,491,891 dozen. At the end of the twelve months period ending April, 1956, shipments have reached a total of 61,132,587 dozen, which is a decrease from the 62,114,702 dozen shipped in the 12-month period ending April, 1955.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during April, 1956 were 2,619,124 dozen. During April, 1955, sales were 3,083,675 dozen. At the end of the 12-month period ending April 30, 1956, manufacturers had sold a total of 36,632,248 dozen, which was 2.8 per cent lower than the 37,694,715 dozen during the corresponding 1955 period.

Errata: In our June, 1956 issue under GLASS CON-

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New Equipment and Supplies

ABSOLUTE PRESSURE TRANSMITTER

The Bristol Company, Waterbury 20, Connecticut, have just announced a new absolute pressure transmitter. It measures pressures in ranges as low as 0 to 5 mm Mercury Absolute and transmit the measurement as a 3-15 psi pneumatic signal to an automatic controller or receiver.

The metagraphic absolute pressure transmitter is offered to handle pressure ranges from 0-5 mm Hg to 0-760 mm Hg. It transmits a universal 3-15 psi pneumatic signal and can be used with any standard pneumatic receiver or automatic controller. Further information on this item may be had by writing the company.

WELL TYPE MANOMETERS

The Henry G. Dietz Company have announced the Cat. 105 Well Type Manometers used for making accurate measurements of pressure, vacuum and differential pressure, either in units of inches of water or inches of mercury. These units have the advantage of being able to be wall mounted or used on a table top. Conversion from wall mounting to table top use is made by fastening two sheet metal brackets supplied with each unit to the sides of the manometer. Straight wall Pyrex tubing is used as the indicating tube which is connected directly to a Pyrex well.

The manometers are supplied with over pressure safety traps, constructed of brass to prevent loss of fluid due to surge in line pressure. Scales are made by the Dietz photo-chemical nameplate process. All manometers are supplied with standard scales, but if special scales are desired, they can be imprinted to any specifications at slightly extra cost.

HEAT DETECTOR CELL ACCESSORIES

The Servo Corporation of America, 20-20 Jericho Turnpike, New Hyde Park, L. I., New York announces the Servotherm Heat Detector Cells, which are used wherever heat is a factor to be measured or controlled, to handle processes in motion that are too fast, too "hot," too inaccessible or too rigid in specifications to permit direct contact with the product under control. Servotherm accessories are designed to fully exploit the outstanding heat detector cell features of speed sensitivity, compactness, wide range, flexibility and low noise.

The Model 1321 Preamplifier is designed to retain maximum sensitivity at high impedance and low signal levels. Accurate initial amplification of 2.0 microvolt signals at an impedance level of 1.5 megohms (typical detector cell resistance) is accomplished by extreme care in construction.

The 1322 Preamplifier is designed to eliminate internal noise due to high ambient vibrations. This is done by potting the carefully selected components in plastic. This unit, providing initial amplification for low input level signals at audio and sub-audio frequencies is also eminently applicable to subsonic vibration, geophysical and electromedical requirements.

AUTOMATIC QUALITY CONTROL THROUGH CONTINUOUS COLOR SAMPLING

Kaye Development Company, a subsidiary of Atomic Instrument Company, Cambridge, Massachusetts have developed a new method of control in manufacturing processes, through the use of wave length absorption from a continuous flow of materials or finished products, through the use of Spectrostats (Kaye method of wave length deviation measurement).

Gasses, liquids, slurries, sheets or a flow of unit solids may be monitored by this method which can sense deviations in absorption bands within preselected limits. The Spectrostat provides continuous sampling of any of these forms and indicates the direction of deviation beyond the set limits by a visual and/or audible warning. A 50 millivolt proportional output provides direct process control. Observations may be made in the range from ultra-violet through near infra-red. Operation of the instrument depends on a sensitivity to an actual change in absorption bands, achieved by splitting the beam between two or more detectors of different spectral sensitivity. A patent-applied-for feature makes possible the simultaneous monitoring of color and turbidity; or two or more components of a stream by use of the single instrument.

The instrument is supplied in either standard or explosion-proof housings; sensing elements may be operated remotely from the indicating unit. Each indicator may use information from several sensing units located along the product flow stream.

CATALOGS RECEIVED

Hinde & Dauch, Sandusky, Ohio, have just issued a package testing booklet for manufacturers who package their merchandise in corrugated boxes. The booklet contains valuable information regarding the testing of packages. Entitled "How To Test Corrugated Boxes" it acquaints producers with the importance and the techniques of package testing, provides a comprehensive check-list by which to judge the protective qualities and general efficiency of specific corrugated boxes. Individual checks to which boxes are normally subjected are described and illustrated in detail. Testing terminology is fully defined. The booklet may be obtained by writing the company.

Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia 44, Pennsylvania have issued a new 24-page catalog EN-S3 which describes the complete line of 8890 Series Rayotube (heat radiation) Detectors, for continuous temperature measurement to 5000° F. and beyond.

Leeds & Northrup have also recently issued a new data sheet E-51(3) which gives complete information about L & N's Type K-2 potentiometer. The 4-page publication points out the widespread use of this potentiometer in industrial and research laboratories for potential difference measurements, for instrument checking and for precise temperature measurements.

Eisler Engineering Company, Inc., 750 South 13 Street, Newark 3, New Jersey, has just released an indexing turntable catalog embodying about 150 various types of indexing turntables, rotating turntables and tables that can be set to practically any desired angle.

This most interesting catalog/represents a small portion of the different types of turntables which this company manufactures. For further information Catalog No. 88-56 and 88-56-C should be requested direct from the company.

Acheson Colloids Company, Division of Acheson Industries, Inc., Port Huron, Michigan has issued a newly revised 4-page booklet listing 42 colloidal and semi-colloidal dispersions, including operational and mold release lubricants for the glass and other industries. These products include dispersions of graphite, molybdenum disulfide, mica, vermiculite, zinc oxide and acetylene black. Carriers and diluents are given for each product, along with typical applications and important physical data.

Copies of "A List of 'dag' Dispersions for Industry" may be obtained by writing the company.

Fisher Scientific, 717 Forbes Street, Pittsburgh 19, Pennsylvania, has just issued the new Fisher Catalog Supplement which describes in just over 100 pages, all of the instruments, apparatus, glassware, laboratory furniture and accessories added to Fisher stocks since the publication of their 1952 Catalog.

All the items in the new supplement, which can be inserted right inside the front cover of the catalog were carefully selected and tested by the technical staff of the company.

THE ITALIAN GLASS INDUSTRY IN 1955

The Italian glass industry consisting of approximately 220 firms and 2,500 workers, with a production capacity valued at 5,000,000 metric quintals (100 kilograms—1 quintal) of glass products, registered in 1955 registered an effective output of about 3,200,000 mq. as against 3,070,000 mq. in the preceding year. The following is some data about the situation of its various branches.

Italian Glass Output in 1955 (according to estimates)

Categories of products	Quantity (mq.)	Per cent
Glass panes of any type	990,000	30.93
Articles for buildings (pressed products and mosaic)	90,000	2.81
Green glass (florentine flasks, bottles, demijohns)	225,000	7.03
White glass in general	200,000	6.25
Flasks and bottles of any type and color	1,528,000	47.75
Articles for technical and industrial uses	60,000	1.88
Articles for scientific uses, sanitary products, tubes and similar articles	47,000	1.47
Artistic products and glass beads	60,000	1.88

In flat glass, the total output showed a slight improvement in comparison with 1954. Appreciable quantities of some special types of glass panes were sold abroad (much of it on the American market).

In white glass in general, the plants maintained their preceding capacity; the output showed a decrease for the pressed, fancy articles, but remained unvaried in blown glass. The national market was heavy for pressed products because of massive imports from both OECE and communist-dominated countries. Easier absorption was noted for blown glass, epecially in fine articles.

The exports of white glass articles remained at the same level as in the preceding year.

In mechanical hollow glass (flasks and bottles of any type and color), the output presented, on the whole, a good increment in comparison with 1954. Despite that, the consumers' demand did not attain the level forecast by the Italian producers, and the slightly increased production was utilized only in part. The situation was aggravated by the competition of some foreign countries, causing a large affluence of their products (sold at anti-economic prices) to the Italian market. The local demand and the course of sales were normal; no important export was registered.

No change was noted in green glass during 1955. The effective output showed a slight increase, in comparison with the preceding year.

No change was registered in the production of articles for buildings (pressed products and mosaic). The level of the demand and sales on the national market was regular, while the exports showed a slight increment.

In other categories (artistic glass, glass beads, tubes, etc.) no important event was registered in 1955. The output roughly maintained the level attained in the preceding year, even if a slight increase in the output and exports of the famous Murano products was evident (the USA demand was particularly good in this branch).

The supply of the primary materials needed by the glass industry was, on the whole, regular with the exception of some scarce metallic oxides and consequently high-priced on the international markets.

WESTINGHOUSE PROMOTES DR. K. H. SUN

Dr. K. H. Sun has been promoted to advisory engineer in charge of the Radiation and Nucleonics Laboratory of the Westinghouse Electric Corporation. The Laboratory is the only one of its kind, at present, in the central engineering activity of the company. It includes the facilities of a modern 2 Mev Van de Graaff machine both for electrons and positive ions and a radioactive laboratory.

Dr. Sun worked as a research chemist from 1942 to 1946 at the Kodak Research Laboratories where he developed more new types of optical glass than anyone in history since Otto Schott formed the Jena Glass Works. In 1946 he entered the field of nuclear physics as a research physicist at the Westinghouse Research Laboratories. He was perhaps the first one in the United States to use a scintillation counter for detecting neutrons. He was also one of the first to measure the delayed neutrons from fast neutron fissions. This data is essential to the design of fast breeders. He was also the first to make a photographic pattern of neutron diffraction using the powdered method. Recently, he has devoted his time to the effect of atomic radiation on materials and industrial application of radiation. He has about 110 scientific and technical publications including over 30 U.S. Patents. He is a fellow of the American Ceramic Society and is well known to glass scientists and technologists throughout the world.

PENNSYLVANIA GLASS SAND ESTABLISHES SCHOLARSHIPS

A scholarship program has been made available to ceramic engineering students by the Pennsylvania Glass Sand Corporation in order to encourage promising young men in the study of this field and thereby help alleviate the serious shortage of graduate ceramic engineers available to industry.

A total of twelve colleges and universities have been selected to participate in this new scholarship program and, beginning with the current school year, annual grants will be given to the schools for presentation as the Pennsylvania Glass Sand Corporation Merit Award Scholarship. Under the provisions of the program, full tuition for the senior year will be awarded to the junior student attaining the highest scholastic average in ceramic engineering at each school.

The schools participating in the scholarship program are Alfred University, Georgia Institute of Technology, Iowa State College, Pennsylvania State University, Rutgers University, The Clemson Agricultural College, The Ohio State University, The University of Texas, University of Illinois, University of Missouri School of Mines & Metallurgy, University of Washington, and Virginia Polytechnic Institute.

• Dr. Emil Ott, vice president and director of chemical research, FMC Chemical Divisions, announced that Mr. S. Philip Marcus will be business manager at the Princeton center, where long range research programs will be carried out for the benefit of all six operating divisions.

• Appointment of Clair W. Van Etten to the newly created position of Corning Glass Works West Coast Sales Manager was announced by Benjamin S. Peirson, assistant director of sales for the company.

Inventions and Inventors

(*Continued from page* 392)

11, 1949; 2,539,329, Sanders, Jan. 23, 1951, and 2,566,960, Philipps, Sept. 4, 1951.

Tube and Cane Machines

Tubulating Machine Chuck. Patent No. 2,731,772. Filed March 30, 1953. Issued January 24, 1956. Two sheets of drawings; none reproduced. Assigned to Western Electric Company by John Ehret, Jr. and E. A. Heckman.

In the manufacture of miniature tubes it is necessary to tubulate the tubes, and in doing so, considerable difficulty has been experienced not only in positioning the bulbs and tubes with respect to each other but in holding them in proper alignment and in abutting engagement with each other while subjecting them to heat sufficient to fuse them together.

In the present invention, the support is one of many, rotatably mounted, at equally spaced positions, about a vertically positioned turret, which moves intermittently from one station to another. During the intervals of rest, a bulb is fed to its respective chuck and accurately located therein by the aid of an annular locating member and companion radially positioned stops, associated with accurate gripping elements which serve to hold the bulb in a given position. The other chuck is open at both ends to receive the tube from one end, for movement of its leading end into engagement with the bulb, this chuck having spaced gripping means to assure its alignment with the bulb permitting removal of the tube from the other end of the chuck.

There were 5 claims and the following references cited in this patent: 918,669, Graybill, Apr. 20, 1909; 1,891,436, Mitchell, Dec. 20, 1932; 2,023,628, Van Sant, Dec. 10, 1935; 2,343,570, Nelson, Mar. 7, 1944; 2,376,540, Iden, May 22, 1945; 2,447,569, Eisler, Aug. 24, 1948, and 2,549,762, Baker et al., Apr. 24, 1951.

Glass Block. Patent No. 2,724,260. Filed December 6, 1952. Issued November 22, 1955. One sheet drawings; none reproduced. Assigned Pittsburgh Corning Corp. by Dominic D'Eustachio.

The present invention relates to a glass building block having its opposite exterior faces covered with a mortar repellent coating.

In the erection of glass building blocks there is usually a certain amount of mortar which is inadvertently deposited on a face or faces of the block thereby rendering it unsightly. This mortar must be removed in order to present a clean, neat looking wall. If this excess mortar is allowed to remain on the face of the block for any length of time, it is exceedingly difficult to remove. This difficulty has been overcome by covering the exterior faces of the block with a transparent mortar repellent siloxane resinous film.

Typical organopolysiloxanes which may be employed are polymers of methyl siloxane, dimethyl siloxane, ethyl siloxane, methyl-ethyl siloxane, methyl-propyl siloxane, etc. The amount of organopolysiloxane coating which is necessary to render a face of a glass block mortar resistant is very small (about 0.3 cubic centimeters per square foot.) One method of applying the films, in accordance with the present invention, is to apply the siloxane as a vapor to the opposite exterior faces of the block at a suitable area in an annealing lehr so that the coating wilt be baked on the block during the annealing process. Some siloxanes require only mild heating to render them mortar resistant, whereas other require no heating at all to render them mortar resistant.

If, during construction, any excess mortar should adhere to the face of a glass building block coated with an organopolysiloxane film, it can be easily and completely removed by rubbing the block with a soft-bristled brush without marring the face of the block.

There were 8 claims and 10 references.

Miscellaneous Processes

Fiber Glass Pipe. Patent No. 2,731,067. Filed November 20, 1950. Issued Jan. 17, 1956. One drawing; not used. Assigned East Coast Aeronautics, Inc., by R. G. Miller.

This invention relates to reinforced plastic of synthetic resin pipe and to a method and apparatus for its manufacture.

It has been found that by wrapping a mandrel with glass fibers at an angle of about 63.4° to the axis of the mandrel, enveloping the wrapped mandrel in liquid thermosetting resin within a mold, setting the resin by heating and stripping the so-formed pipe from the mandrel that the pipe can be continuously produced of any desired uniform size, having an optimum proportioning, between hoop and longitudinal stresses, to provide a maximum ratio between strength and weight.

The pipes have a tensile strength of the order of 150,000 p.s.i. Such pipe may be substituted for welded steel pipe of the same diameter but weighing about 10 times as much. There were 10 claims and 15 references.

AMERICAN WINDOW GLASS ADDS TWO NEW GLASS FURNACES

American Window Glass Company of Pittsburgh has begun construction of two new glass making furnaces at factories located in Jeannette and Arnold, Pa. Planned as part of the company's modernization program, the furnaces are specifically designed for the manufacture of gray and green glass to strengthen the company's position in the industry.

The green "tank", scheduled to be in operation in Jeannette by year end will increase the factory's drawing capacity by 30 per cent, through the addition of three new 100 inch drawing machines.

The gray glass furnace, expected to be "under fire" in Arnold, Pa., early in September of this year will add approximately 25 per cent to the factory's drawing capacity. Three new drawing machines will bring to a total of 14 the number in operation at that site.

The green colored glass, trademarked "Lustrakool" is heat absorbing and glare reducing. It will principally be used for the production of laminated safety glass for the automobile industry. The gray glass named Lustragray has as its principal market the television industry.

• The Los Angeles plant of American Potash & Chemical Corporation recently received an award from the National Safety Council for an accident-free 1955.

Current Statistical Position . . .

(*Continued from page* 394)

TAINER PRODUCTION page 335 . . . "Thus far in 1956 glass container production reached 36,077,000 gross . . .; this should have read . . . 46,077,000 gross, which is 7.4 per cent over last year's 42,882,000 gross production for the similar period.

1955 EXPORTS AND FOUR-YEAR TREND

The table given below is intended to show a four-year summary of glass exports, 1952-1955, of the principal types of glassware and the dollar value.

In the four-year summary report, although handmade "tumblers and stemware" dollar exports increased 25.5 per cent and dozens increased 93.2 per cent, apparently the increases were made at sacrifices in the price average —down 35.0 per cent, in order to compete with other countries in foreign markets. Combining dozens for the handmade "tumblers and stemware" and "table, art and kitchen" ware, the increase in 1955 over 1954 was 7,987 dozen, from 35,017 to 43,004 in 1955, up 22.8 per cent. On the same basis in dollars, exports remained static; only an increase from $222,201 in 1954 to $223,904, up $1,073 or 0.8 per cent.

CARBORUNDUM ACCELERATES EXPANSION PROGRAM

Due to a marked increase in the past months for Carborundum's fused-cast refractories, the Falconer plant's rebuilding program has been stepped up.

The directors have authorized the acceleration of the rebuilding program which had been originally planned to take place during the next five years. Contracts have already been placed for new buildings, crude materials handling and for additional furnace capacity. It is hoped that the expanded plant will be in complete operation by the first of 1957.

O-I PLANS MULTI-MILLION DOLLAR BOTTLE MANUFACTURING PLANT

Plans for construction of a multi-million dollar bottle manufacturing plant at San Jose de las Lajas, 20 miles southeast of Havana, were announced by Owens-Illinois Glass Company.

Work will start on June 15 following ground-breaking ceremonies which will be attended by government and business officials from Cuba and the United States.

The 148-acre site is on the Central Highway and the Occidental Railway about a mile south of San Jose de las Lajas.

Scheduled for completion in the latter part of next year, the plant, equipped with three glass melting furnaces, will be capable of producing about 72 million bottles and drinking glasses per year. The principal products will be glass containers for the packaging of foods, beverages, and drugs. At the outset, the plant will employ about 200, all Cubans, except for a few essential experienced technicians to be drawn from the company's production staff in the United States.

The plant will be operated by Compania de Vidrios Owens-Illinois de Cuba, S. A., a wholly-owned O-I subsidiary. It will be one of the most modern and completely integrated of O-I's 31 plants.

FOUR-YEAR SUMMARY OF GLASS EXPORTS 1952 - 1955 INCLUSIVE

Description	*% change 1955 vs 1954*	*1955*	*1954*	*1953*	*1952*
Auto. Machine Tumblers	— .5	$4,005,084	$4,026,646	$4,057,981	$3,624,724
Dozens	— 6.8	6,281,389	6,738,709	6,223,708	5,731,567
Average Price Per Dozen	+ 6.9	63.8¢	59.7¢	65.2¢	63.2¢
Handmade Tumblers & Stemware	+ 25.5	$ 29,511	$ 23,516	$ 37,040	$ 27,807
Dozens	+ 93.2	10,707	5,543	11,149	8,180
Average Price Per Dozen	— 35.0	$ 2.756	$ 4.242	$ 3.322	$ 3.399
Cook. Heat Resistant Ware	+ 36.2	$1,380,518	$1,013,600	$1,491,559	$ 878,804
Dozens	— 10.1	531,453	591,194	744,677	453,989
Average Price Per Dozen	+ 51.4	$ 2.597	$ 1.715	$ 2.003	$ 1.936
Auto. Machine Made Table, Kitchen and Cooking Ware	+ 2.4	$4,327,326	$4,227,685	$5,199,207	$5,190,376
Dozens	— 12.1	4,128,195	4,698,971	5,205,375	5,792,217
Average Price Per Dozen	+ 15.3	$ 1.048	90.9¢	99.9¢	89.6¢
Handmade Table, Art & Kitchen	— 2.2	$ 194,393	$ 198,685	$ 284,111	$ 284,805
Dozens	+ 9.6	32,297	29,474	40,399	55,165
Average Price Per Dozen	— 10.7	$ 6.018	$ 6.741	$ 7.032	$ 5.162
Lamp Chimneys & Lantern Globes	+ 2.9	$ 610,686	$ 593,560	$ 558,869	$ 512,586
Globes & Shades (Lighting)	+ 12.3	$1,902,286	$1,693,406	$1,731,394	$1,786.914
Glassware Chemical, exc. Tubing	+ 11.5	$2,686,457	$2,409,103	$2,260,803	$2,378,370
Elec. Glass Insulators	+114.2	$ 584,613	$ 272,924	$ 249,262	$ 320,296
Glass Tubes, Tubing, Rods, Canes	+ 31.7	$2,828,039	$2,147,777	$2,254,045	$2,018,322
Elec. Light Blanks	+ 34.5	$2,260,045	$1,680,774	$1,930,491	$1,277,298
Glass Electron Tube Blanks	+ 64.6	$9,451,534	$5,742,385	$3,994,762	$1,220,241
Glass Products N.E.C.	+ 48.3	$5,900,177	$3,977,513	$3,460,302	$3,285,876

(*Continued from page* 385)

the oxide mixture as a mixture of oxygen ions in different energy states, we may by convention attribute any change in energy of the system to a change in the energy state of the oxygen ions. It should be mentioned that this definition implies that even an energy change due to a direct cation-cation interaction is thus described as a change in the energy of the oxygen ions.

Our measure of relative basicity, the partial free energy of the basic constituent, e.g., Na_2O, also implies the entropy of mixing. For a system like SiO_2 and Na_2O this seems reasonable. The acid-base reaction can be described by:

$$Si^{4+} - O^{2-} - Si^{4+} + O^2 = 2\ (Si^{4+} - O^{2-})$$

where $Si^{4+} - O^{2-} - Si^{4+}$ is an oxygen ion forming a bridge between two Si^{4+} ions and the two $Si^{4+} — O^{2-}$ represent a broken bridge. An acid silicate may thus be described as a mixture of these two kinds of oxygen ions and the entropy of mixing may be treated on this basis. It should be noted that the mixture of the Si^{4+} O^{2-} Si^{4+} and Si^{4+} O^{2-} Na^+ groups deviates strongly from an ideal mixture even at fairly small concentrations of Na_2O in SiO_2[13] due to the interaction of the Si^{4+} O^{2-} Na^+ groups.

If, however, the sodium ions in this glass are substituted to a large extent by potassium ions and we still use the free energy of Na_2O as a measure of the basicity, it is obvious that our basicity concept has lost its original significance. Na_2O will have a very low partial free energy in the alkali silicate having a high potassium/sodium ratio because the partial entropy of the Na^+ ions will be very high. Thus, according to the above definition of basicity, the system becomes less basic as sodium ions are replaced by potassium ions, and the basicity approaches $-\infty$ as the fraction of sodium ions approaches zero. Such a basicity concept is of no use, and it would be contrary to that shown by an acid-base indicator (like Cr^{3+}—Cr^{6+}).

This last difficulty could be overcome to some extent by always referring the basicity of a system to a standard system with cations in the same relative amounts. Thus, the basicity of a sodium-potassium silicate with equal amounts of sodium and potassium ions should be referred to a mixture of equal amounts of Na_2O and K_2O having unit basicity. However, according to this definition, one cannot compare the basicity of systems having different cations or different ratios of cations.

To avoid this problem one could by definition denote a basicity equal to zero only to Cs_2O. The basicity of the other reference systems, like Na_2O, K_2O, or their mixtures, could be directly related to the difference in lattice energy for this reference oxide and Cs_2O. Thus, to keep the basicity as a quantitative concept and to avoid its becoming misleading, we would end up with a very sophisticated basicity concept which probably would be of no practical use.

To avoid this dilemma we will use the basicity concept only when comparing systems which have the same kinds of alkali ions.

c. *Interpretation of Experimental Results*

In comparing the basicity of the glasses in series 4, we will use the partial free energy of Na_2O as a measure of the basicity and as standard state we will use arbitrarily Na_2O in the glass of composition $Na_2O{\cdot}3SiO_2$.

According to equation (1) the EMF measured for the different cells in series 4 is a direct measure of the relative basicity of the different glasses. However, one has to bear in mind the assumptions on which the validity of equation (1) is based. Figure 2 shows a plot of the EMF or the relative basicity as a function of the composition at two temperatures. As is seen from the figure the basicity decreases gradually with increasing, SiO_2/Na_2O ratio, and the difference in basicity of two glasses increases with increasing temperature. The sodium silicate glass may be considered as a mixture of two kinds of oxygen ions, those connected between two Si^{4+} ions forming a bridge between them, Si^{4+} O^{2-} Si^{4+}, and those connected to only one Si^{4+} ion, the non-bridging Si^{4+} O^{2-} Na^+. The change in relative basicity with temperature corresponds to an entropy of mixing the two kinds of oxygen ions. However, it should be stressed that this mixture deviates strongly from an ideal mixture. Deviations even at small contents of non-bridging oxygens are found from the phase diagram SiO_2 – Na_2O[13].

The cells used in series 5 are similar to those used in the preceding ones, the only difference being that MgO has been added to both glasses of a cell. As before, the basicity increases with decreasing SiO_2/Na_2O ratio of the glass. However, the measurements showed one distinct difference compared to the preceding ones. The EMF was practically independent of temperature. This means that the entropy of mixing the bridging and non-bridging oxygen ions is zero or very small for a glass containing magnesia. Such a low entropy of mixing may be pictured as the formation of clusters of non-bridging oxygen ions and Mg^{2+} ions. It may be compared with the formation of two immiscible liquids in the system SiO_2 – MgO. The presence of soda in the glasses used here may enhance a bridging of the clusters and SiO_2–rich regions of the glass so the clusters do not continue growing to form a separate phase.

In series 6 the relative basicity is measured of a glass of composition $Na_2O{\cdot}3SiO_2$ and one in which some of the Na^+ ions are replaced by Mg^{2+} or Ba^{2+} ions. As is seen from Figure 3 the introduction of Mg^{2+} or Ba^{2+} ions into a glass decreases the basicity very much. The same effect of these ions on the basicity of sodium borate glass was observed by H. Lux and E. Rogler[14] using color indicators. The present investigation shows that the basicity of the system is decreased more by the addition of MgO than by an equimolar amount of SiO_2. Similarly, Lux and Rogler found that the addition of MgO to a sodium borate decreased the basicity more than the addition of an equimolar amount of B_2O_3. H. Flood and T. Forland[15] and W. A. Weyl[3] explained this by assuming that the Mg^{2+} or Ba^{2+} ions will surround themselves with a number of non-bridging oxygen ions. These oxygen ions will be strongly tightened by the alkaline earth ions causing a decrease in basicity of the system.

Two properties of the alkaline earth ions are important for the change in basicity. The strength of the electrostatic binding between the alkaline earth ion and the non-bridging oxygen ions, and the coordination number of the alkaline earth ion, determine the maximum number

(*Continued on page* 402)

G.C.M.I. Meeting . . .

(*Continued from page* 380)

my contacts with my fellow trustees and with the staff and, I hope, through this period I have made some contribution to the Institute and the industry. One thing I know for sure is that I shall greatly miss these regular get-togethers."

In addition to individual reports by H. W. Kuni, the Institute's secretary and treasurer, L. G. Gehring for the Committee on Testing Procedures, F. B. Pollock, chairman of the Committee on Market Research and Promotion and R. L. Cheney, its director and A. J. Martin, the Institute's director of Labor Relations, the membership was treated to two interesting talks by invited speakers. Lemuel R. Boulware, vice president of Public and Employee Relations of General Electric Company spoke on "Planning Employer-Employee Relations" and at the close of the three day interesting an inspirational talk "Efficiency Through Right Thinking" was delivered in his inimitable style by Dr. Norman Vincent Peale.

On the social side, the Fairmount Glass Company was host to the members of the industry and their guests at a delightful cocktail party held in good weather in the Auditorium Patio of The Greenbrier.

The annual banquet was, as usual, quite successful and the weather-man was also kind to a large number of golfers who entered the tournament to compete for the many fine prizes available.

It was announced by J. M. Foster, president, Foster-Forbes Glass Company, that the semi-annual meeting would be held November 13, 14 and 15 at the Arizona Biltmore Hotel, Phoenix, Arizona.

Mr. and Mrs. Franklin B. Pollock (Left), Thatcher Glass Mfg. Co., Inc.; Mr. and Mrs. H. C. Herger, Pierce Glass Company (Right).

PRICE REDUCTION ON SILICONE MOLD

A price reduction of approximately four per cent for silicone mold release emulsions has been announced by the Silicone Products Department of General Electric Company, Waterford, N. Y.

The department noted the reduction reflected the increasing use of silicone mold lubricants in a wide variety of release applications in the rubber, plastics, foundry, die-casting, and other industries.

DIAMOND ALKALI PROMOTES C. J. OTT

Appointment of C. J. Ott as administrative assistant in the Soda Products Division of Diamond Alkali Company, Cleveland, Ohio, was announced here by Henry B. Clark, General Manager of the division.

Mr. Ott, who joined the Controller's Department in October, 1951, now takes over new, broader responsibilities in the division's administrative section.

CONTINENTAL CAN AND HAZEL-ATLAS TO MERGE

Plans for merger of Continental Can Company, Inc. and Hazel-Atlas Glass Company have been announced by Gen. Lucius D. Clay, chairman of Continental Can, and John Harrison McNash, chairman of Hazel-Atlas.

The agreement, which will unite one of the industry leaders in the packaging field with a major manufacturer of glass containers, is subject to approval by stockholders of Hazel-Atlas at a special meeting planned in August.

The terms of the plan will result in a ratio of 46/100 share of Continental for one share of Hazel-Atlas.

C. P. LOHMAN ELECTED VICE PRESIDENT OF PEMCO

Charles P. Lohman has been elected a vice president of the Pemco Corporation following a regular meeting of the Board of Directors, according to an announcement by Richard H. Turk, chairman.

Mr. Lohman has been sales manager for the company since 1944, and prior to that he was manager of ceramic sales for five years.

Mr. Lohman has been an active leader in the Porcelain Enamel Institute for many years, and is currently chairman of the Aluminum Division of the Institute.

CORNING GLASS APPOINTS THOMAS HOWITT

Thomas Howitt has been appointed a supervisor of machine development in the mechanical engineering department of Corning Glass Works, it was announced recently by Arthur W. Weber, director of engineering.

Mr. Howitt joined the Parkersburg, W. Va. plant in 1950 as an equipment engineer. In 1952 and until this appointment he was a machine designer in the mechanical engineering department at Corning.

CONSOLIDATED FELDSPAR TO MOVE HEADQUARTERS OFFICE

The Consolidated Feldspar Dept., International Minerals & Chemical Corp., will move its departmental headquarters from Erwin, Tenn., to Chicago, Ill., on July 2, 1956. Effective that date, all correspondence, orders and other matters pertaining to the department should be addressed to: Consolidated Feldspar Dept., International Minerals & Chemical Corp., 20 N. Wacker Dr., Chicago 6, Illinois.

The move is being made to place the department in closer contact with the corporation's other divisions, enabling it to provide faster information to customers.

LACLEDE-CHRISTY OPENS NEW CHEMICAL LABORATORY

Laclede-Christy Company Division, H. K. Porter Company, Inc., has just added a small but complete Chemical Laboratory which now supplements its facilities for physical testing and petrographic laboratories in providing complete data on raw materials and finished products.

New trends in the use of refractories

Service reports prove economy in installation, economy in use of CAST 400 Bottom Blocks

Proof of savings with CAST 400 Bottom Blocks shows up not just occasionally—but consistently. Here are some examples:

1. 35 months service, producing 109,423 tons of flint glass in one campaign. CAST 400, originally 12" thick was 4¼" to 8¼" thick in the tank bottom at campaign's end.
2. More than 34 months service, producing 199 tons of flint glass per sq. ft. of melting end for the life of the furnace. At campaign's end, CAST 400 was 8 in. thick at the thinnest spot in the bottom!
3. More than 43 months campaign, in 22 in. deep tank, producing 219.8 tons of flint glass per sq. ft. of melting end for the life of the furnace.

Are you getting satisfactory service life with the bottom blocks you are presently using? Are you getting the advantages of CAST 400 Bottom Blocks? When may we talk with you about them?

LACLEDE - CHRISTY COMPANY

DIVISION OF H. K. PORTER COMPANY, INC.

2000 Hampton Avenue · St. Louis 10, Missouri

Acid Base Relationship . . .
(*Continued from page* 399)

of non-bridging oxygen ions which may surround one alkaline earth ion. On this basis one can understand why an addition of MgO to a sodium silicate can decrease the basicity more than an addition of the same molar amount of SiO_2 (see Figure 3).

In series 7 the basicities of different glasses having the composition $Na_2O{\cdot}RO{\cdot}5SiO_2$, where R is Mg, Ca, or Ba, are compared. As is seen from the EMF measured, the basicities of these glasses decrease in the order Ba-glass > Ca-glass > Mg-glass. Comparing these three alkaline earth ions, the Mg^{2+} ion has the highest field strength, but the Ba^{2+} will generally have the largest coordination number. So for the compositions investigated, the strength of the electrostatic binding between the oxygen and the alkaline earth ion is more important than the coordination number in determining the basicity of the system. For the sodium borate systems investigated by Lux and Rogler[14] the opposite was found for smaller additions of alkaline earth oxides.

In series 8, the basicity of a glass of composition $K_2O{\cdot}MgO{\cdot}4SiO_2$ and one of composition $K_2O{\cdot}(1\text{-}x)MgO{\cdot}xBaO{\cdot}4SiO_2$ are compared for different Mg/Ba ratios. The Ba-containing glasses are found to be the most basic and the basicity increases gradually with increasing barium content. This is in agreement with the conclusion from series 7 just given.

In series 9, the EMF is measured for cells having two glasses containing different mixtures of Na^+ and K^+ ions. As mentioned before, this creates a problem concerning the definition of what we mean by basicity. We will, therefore, discuss the EMF of the cell composed of the different glasses instead of discussing the relative basicities of the glasses.

It seems reasonable that in a cell contaning the two glasses $Na_2O{\cdot}3SiO_2$ and $K_2O{\cdot}3SiO_2$, the negative electrode is the one which is in contact with the potash glass, because one would expect that less energy is needed to remove and discharge an oxygen ion in the group K^+ O^{2-} Si^{4+} than in the group Na^+ O^{2-} Si^{4+}. It may be more surprising that cells having two glasses of compositions $Na_2O{\cdot}3SiO_2$ and $(1\text{-}x)$ $Na_2O{\cdot}xK_2O{\cdot}3SiO_2$ have a pronounced maximum in EMF as a function of x, as is shown on Figure 4.

One cause of the maximum in the EMF could be the difference in transport numbers of the Na^+ and K^+ ions in the mixed glass. The transport numbers of Na^+ and K^+ have been measured by B. Lengyel [16] for sodium-potassium disilicate glasses, whereas, the glasses investigated here were trisilicates. For a glass containing equimolar amounts of sodium and potassium the transport numbers are 0.65 for Na^+ and 0.35 for K^+. Using the same transport numbers for the glass $0.5Na_2O{\cdot}0.5K_2O{\cdot}3SiO_2$, one can estimate the EMF of the cell containing the two glasses $0.5Na_2O{\cdot}0.5K_2O{\cdot}3SiO_2$ and $Na_2O{\cdot}3SiO_2$ to be 0.013 volt at 500°C, if one assumes that there is no change in energy by mixing a sodium and a potassium trisilicate. Now the observed EMF was 0.04_5 volt. One would also generally expect that a glass containing a mixture of the ions Na^+ and K^+ will have a lower energy than the two separate Na^+-containing and K^+-containing glasses which would give a maximum in the EMF. However, the final interpretation has to await the gathering of additional and more accurate information on the thermal and electrical properties of the glasses.

ACKNOWLEDGMENT

The authors wish to thank Dr. W. A. Weyl and Professor Evelyn C. Marboe for valuable discussions, and the Office of Naval Research for their financial support of this work.

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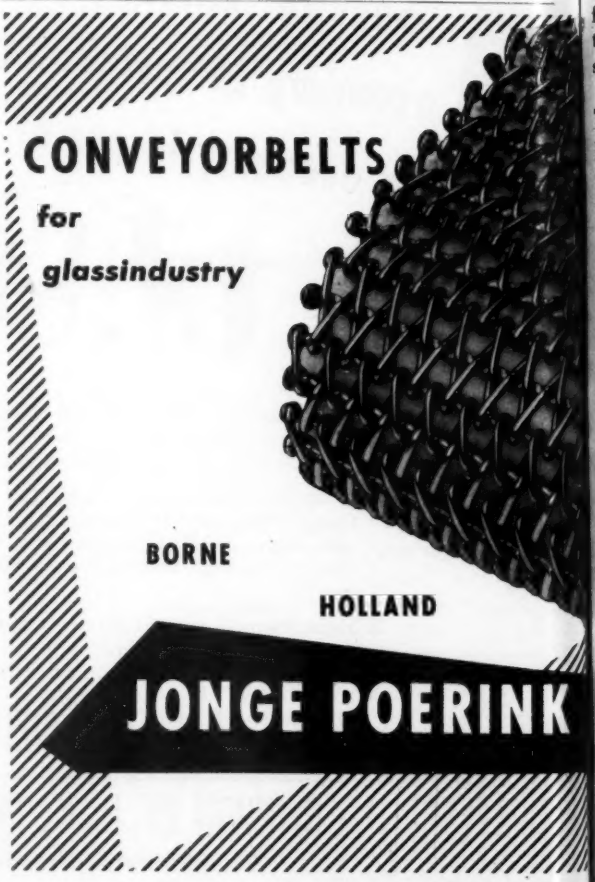
• Curtis W. Davis, Jr., who joined Libbey-Owens-Ford Glass Company as a chemist in technical control in 1948, has been named general superintendent of twin grinding and polishing of plate glass at Rossford plant.



A. S. G. S. Symposium . . .
(*Continued from page* 387)

sion curves for seven glasses were shown. Glass sealing metals were discussed, during which Sylvania's #4 alloy was mentioned as an ideal metal for soft glass seals. A slide was shown which listed metals and the corresponding sealable glasses. Dr. Dalton suggested the use of 7750 glass for large diameter tungsten seals and 7056 glass for Kovar-seals where optical quality is required. A slide showed the application of glass-metal lead-seals in electronic tube stems (headers). The combination of glass with metals having a mismatched coefficient of thermal expansion was reviewed. A slide showed the tapered feathered edge seal of a copper Housekeeper seal and the thin foil seal customarily used in sealing molybdenum to quartz. An aluminum-to-lime glass seal was described as made with an intermediate solder glass.

By the nature of questions asked at previous A.S.G.S. meetings, indications are that less glass metal problems may arise at industrial glass laboratories as a result of this talk.

"Glass Technology", by C. A. Bradley, director of glass melting operations at Corning, was presented next. Dr. Bradley has been engaged as a physicist, glass technologist, superintendent of mixing and melting and in his present position, as director of glass melting operations.

The contents of this paper presented some of the problems associated with the production of glass from raw materials. These problems are often the cause of "gripes" from the fabricators who rework glass tubing. Perhaps from the knowledge gained at this meeting the scientific glassblower will have a greater understanding and sympathy for the problems of the glass manufacturer.

Dr. Bradley described the process of mixing glass. The control of raw materials is important in order to retain the properties of a given glass. The dissolving of refractory tank oxides, by the glass, often impose problems. These faults are of major importance to the television industry where large face plates are required to be nearly flawless in accordance with A.S.T.M. standards.

A description of some common faults in glass and their causes were given. Individually treated were stones, crystallization, bubbles, seeds, blisters, chords and knots. This reviewer feels that the information presented would have been enhanced, had slides been shown of the condition, thereby uniting the flaw with the definition.

Dr. Bradley in discussing gas occlusion in glass stated that, "One cubic inch of glass, when heated in vacuum, could produce one cubic foot of gas. These gases are mainly water vapor and carbon dioxide." This knowledge is of importance to those engaged in high vacuum work, or for those who are contemplating softening glass in vacuum.

"Vycor Brand Glass" by M. E. Nordberg, research chemist was next. Dr. Nordberg has done intensive work on the chemical durability of glass, alkali resistant glasses, glass composition research and is co-inventor of high silica "Vycor Brand" glasses.

The difficulties of reworking very high temperature glasses, such as fused silica and Vycor, are recognized as a major cause for limiting the applications of these ideal glasses. This reviewer looks toward advances in the

(*Continued on page* 406)

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Milestones in Glass Progress

PHOTO COURTESY THE TOLEDO MUSEUM OF ART

1473 This enameled goblet of sapphire-blue glass comes from the workshop of famed Venetian glassmaker Angelo Beroviero. The decoration is a characteristic Italian Renaissance subject: "The Triumph of Fame." Beroviero made many improvements in glassmaking, invented so-called crystal glass in 1465.

1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (South Plant, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte CHEMICALS

Michigan Alkali Division, Wyandotte Chemicals Corporation
Wyandotte, Michigan • Offices in Principal Cities

Founded by a Glassmaker to Serve the Glass Industry

A. S. G. S. Symposium . . .
(*Continued from page* 405)

technology of Vycor glasses, so as to simplify the controls required for the conversion process, thereby making Vycor available in the soft glass state. Dr. Nordberg described the method for preparing Vycor-Brand glass. A melt is made with properties analogous to lime glass. After forming this soft glass, the part is heated to effect a phase change into two distinctly different glasses. One glass being high in silica the other highly soluble in acid. The glass is placed in the acid leaching solution until the soluble portion dissolves out. The porous high silica glass which remains is heated to a high temperature, to fuse the pores without deforming the ware. Shrinking, as a result of this heating, is accounted for by precalculated increase in dimensions. A slide showing the leaching curves was shown.

To prevent deformation and devitrification the safe temperature limit for Vycor Brand glass use was given as 900°C. For short periods this material may be used at temperatures up to 1200°C.

Some hints were given on working Vycor glass, such as the elimination of sublimed silica, adjacent to worked areas, by keeping the areas near seals hot.

Seven varieties of Vycor Brand glass were described, their code numbers and outstanding properties were also given.

Additional information is available by referring to "Properties of some Vycor-Brand Glasses", *Journal of The American Ceramics Society*, Vol. 27, No. 10, October 1949, "Lampworking", by Herman Schrickel Sr., special assistant to divisional manager of manufacturing. Mr. Schrickel joined the Corning Glass Works in 1920 and was instrumental in establishing the apparatus department where he acted as supervisor and manager until 1955. He has contributed to the development of glassblowing techniques and improvements in the design of glassblowing equipment.

The prestige and recognition bestowed on Mr. Schrickel, by the members of the audience, was in keeping with his abilities, contributions and extended association in the field of glassblowing. Mr. Schrickel gave a brief history of lampworking; the early problems produced by the use of inferior glasses and competitive imports.

Mr. Schrickel's advice to glassblowers was, "Stay practical instead of being a scientist". This reviewer's comments are that this form of thinking will hamper the progress made in the attitude and objectives of the new group of scientific glassblowers who are rejuvenating an almost obsolete art. In order for experimental glassblowers, employed in research, to assist and advise the scientist with glass fabrication problems the glassblower must have an understanding of the scientist's manner of thinking. It should further be observed, that the more obvious glass techniques have been exploited. Present day glass shop problems are better solved by having a knowledge of the sciences. To foster new developments for the continued advancement of the art of glassblowing, as is one of the objectives of the A.S.G.S., glassblowers should enrich their backgrounds with a working knowledge of physics, chemistry and mathematics.

The solution to some problems, when re-working Corning glasses, were given. Best results with combustion

(*Continued on page* 408)

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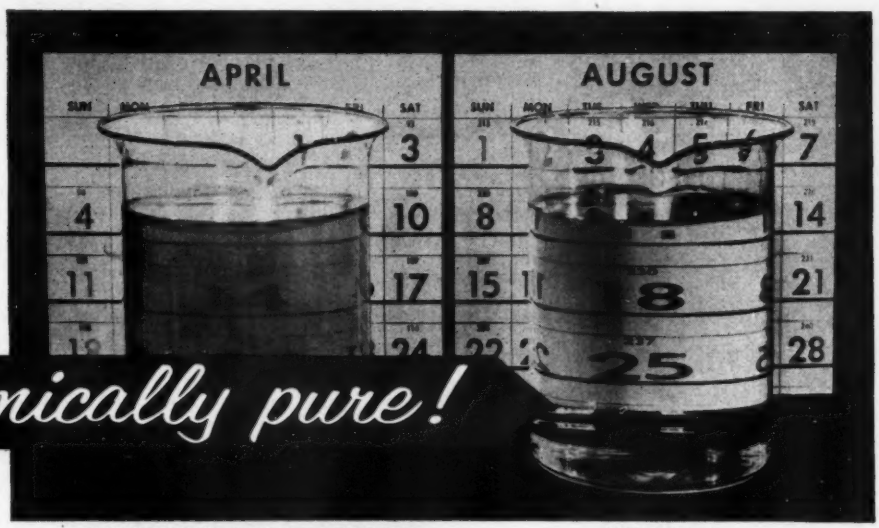

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Help yourself to increased profits now!

The Calumite Co.
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A.S.G.S. Symposium . . .

(*Continued from page* 406)

tubing #1720 can be obtained when worked at low temperatures rather than the faster working high temperatures as is the tendency with hard borosilicate glasses. Care not to overheat glass also applies to alkali resistant #7280 glass, where slower working eliminates surface checks. Chemical Pryex #7740 is subjected to surface boiling when overheated and when not cleaned. It will produced a "scum" on the glass surface.

Heating means were discussed, which included the silent burner used at Corning Glass Works. Mr. Schrickel told how High Frequency sealing heats the glass from the inside as well as on the surface. Safety precautions with 60 cycle electric heating of glass were mentioned.

Very little time was allowed for questions after each paper because of the tight schedule. No questions went unanswered however, because on Saturday morning June 9 the speakers and audience met at the Glass Center for a round table discussion. Presiding over this gathering was J. A. Alexander president of the A.S.G.S. Every conceivable question on glass blowing problems were directed at the panel of experts, who in turn provided a wealth of information.

Thanks go to Corning Glass Works and the members of their staff for their time and knowledge. Further, for providing the A.S.G.S. with the opportunity to bring so large a number of scientific glassblowers together and still further thanks for the unforgettable social events provided.

COLUMBIA-SOUTHERN ELECTS THREE NEW DIRECTORS—INCREASES BOARD MEMBERS

Columbia-Southern Chemical Corporation has elected three new directors and increased the number of board members from 11 to 14, according to an announcement by E. T. Asplundh, president. Columbia-Southern is a wholly-owned subsidiary of Pittsburgh Plate Glass Company.

The three new directors are C. F. Bingham, W. E. Phillips and H. B. Brown.

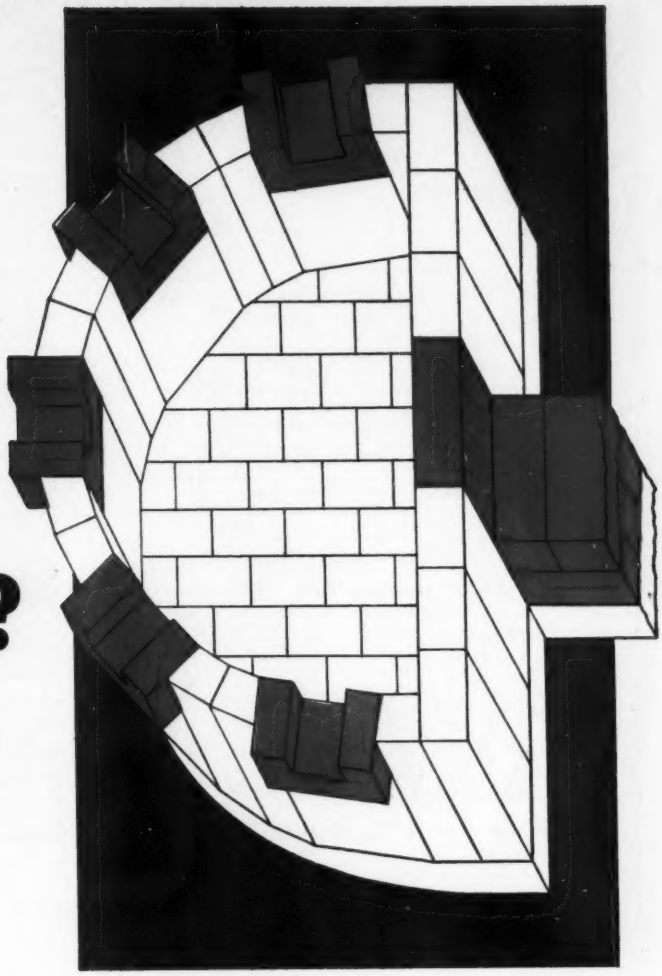
Mr. Bingham is vice president of sales for Columbia-Southern and earlier had served as director of sales for the corporation. He joined the firm as a technical service engineer and during his 16 years' service with the company has held various supervisory sales positions.

Mr. Phillips has served as a director of the Pittsburgh Plate Glass Company since 1950 and is board chairman and chief executive officer of Canadian Pittsburgh Industries Ltd., a wholly-owned subsidiary of Pittsburgh Plate.

Mr. Brown has served as a director of Pittsburgh Plate Glass Company since 1944 and as secretary of the firm since 1939.

• C. R. Megowen, president of the Owens-Illinois Glass Co., Toledo, O., has been named to represent the stone, clay, glass and plastics industries on the National Advisory Council for the national industrial exposition of new industrial products, methods and research developments to be held in Detroit, October 1956. Site of the exposition is the former Vickers ordnance plant, now the Detroit Artillery Armory.

Are your feeder entrances a trouble spot?



Feeder entrances are usually the most vulnerable area in refining ends of continuous glass melting tanks. Here is an area where the most resistant and therefore long-lived material can play an important part in glass quality.

MONOFRAX® M fused cast refractories will give you maximum life in feeder entrances and help improve glass quality. Their dense, tightly locked crystalline structure provides maximum resistance to the corrosive action of most glasses. A life of two or more campaigns is not unusual.

The extreme purity of MONOFRAX M and H refractories plus the practically complete absence of a glassy phase tends to help reduce seeds, stones and cords. They consist of over 98% alumina, with less than 0.2% impurities, and next-to-no interstitial glass.

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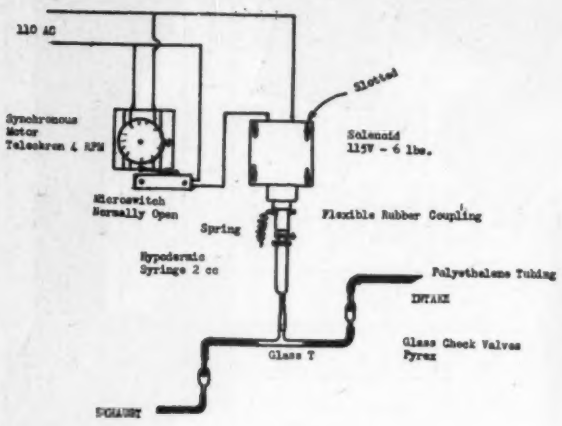
LATHFORD-MARBLE DEVELOPS ACID MICROPUMP



P. W. Robinson, plant engineer and Theodore Vega, chief chemist of Latchford-Marble Glass Company, Los Angeles, California, have designed a new acid micropump which has helped solve a water conditioning problem in this plant.

Basically the pump consists of a hypodermic syringe, actuated by a simple solenoid which in turn is activated by a normally open micro-switch excited by a screw set on side of faceplate of Telechron synchronous motor. (See above drawing.)

The amount of acid injected is controlled in two ways. One by decreasing or increasing the number of screws set on the faceplate of Telechron motor, which consequently increases the number of strokes taken by the syringe. Second by moving the solenoid casing up and down on the slotted openings, thus increasing or decreasing the size of the stroke of the syringe.

HARBISON-WALKER TRANSFERS JOHN J. WEBBER

Harbison-Walker Refractories Company has transferred John J. Webber to the Technical Sales Department in the Cleveland District.

Mr. Webber is a recognized authority on the application of refractories to glass manufacture. He joined the Technical Sales Department of Harbison-Walker in 1954, previously having been associated with Owens-Corning Fiberglas Corporation as chief furnace engineer in charge of furnace construction and refractories. While with Owens-Corning his work resulted in the development of several furnace designs and a gas analyzer burner. He also acquired a personal patent on a timer mechanism.

Mr. Webber is a ceramic engineering graduate of the University of Illinois and is active in the Central Ohio Section of the American Ceramic Society.

HAND BOOK OF GLASS TECHNOLOGY

by

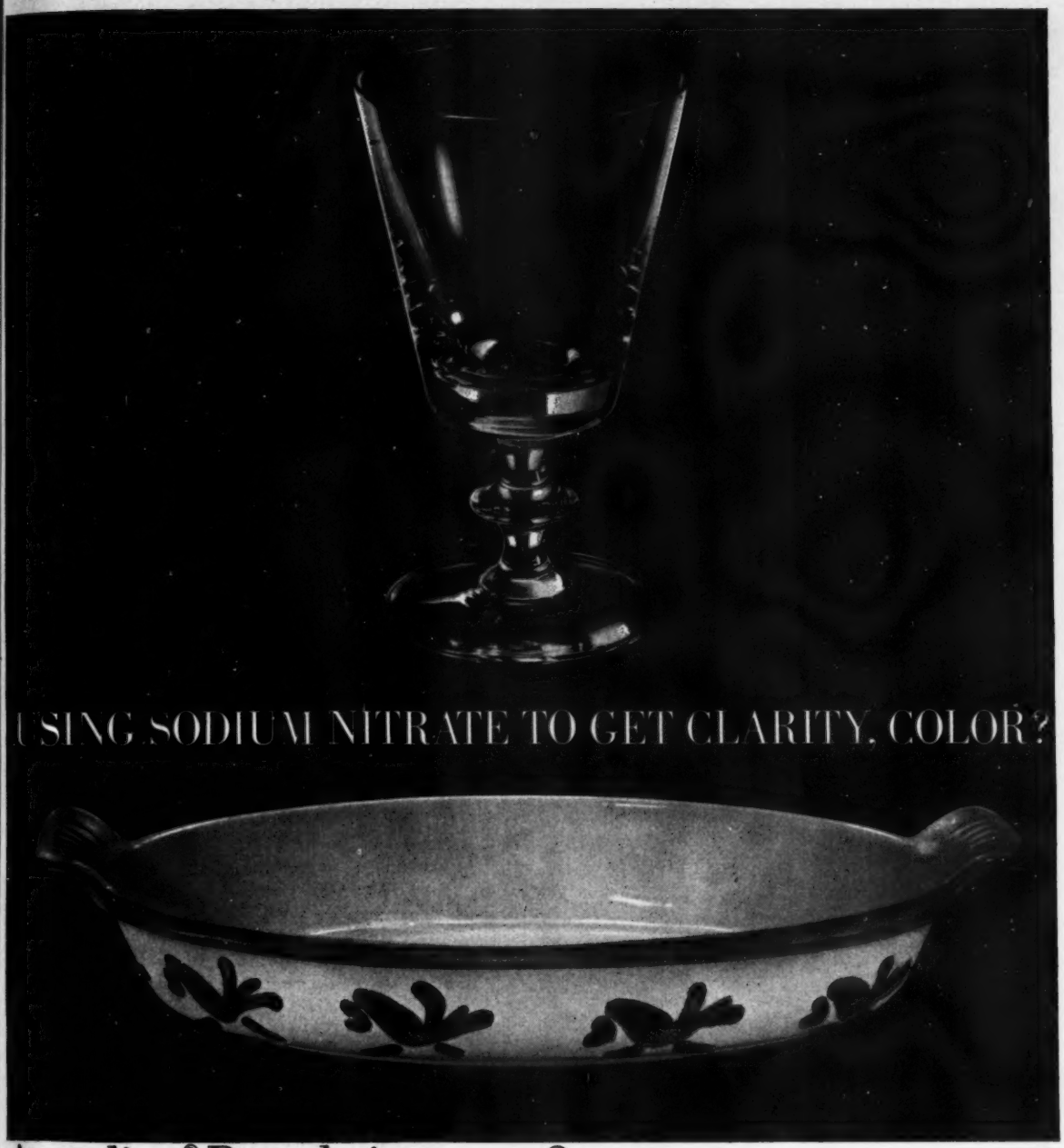
Dr. R. Charan B.Sc. Tech. (Sheff.) Dr. Tech. (Praha)

Professor and Head of the Glass Technology Dept.

Banaras University, Banaras (India)

In a preface, Dr. C. H. Greene, Chairman Dept. Glass Technology, The New York State College of Ceramics, Alfred, New York, says, ". . . A great store of information . . . most useful for students and practical factory people . . . It fills a real need as a textbook . . ."

Revised 1956 Edition—Price $7.00



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Research Digest . . .

(*Continued from page* 393)

exists in its compounds are divalent and tetravalent. Aqueous solutions of H_2PtCl_6 are orange, showing a rapid decrease in absorption from 390 to 420mμ and practically no absorption above 520 mμ. The compound $PtCl_4$ is red-brown. Aqueous solutions of H_2PtCl_4 are yellow and the compound $PtCl_2$ is brown-green. Since yellow to orange colors were obtained with platinum in the alkali phosphate glasses, it is reasonable to assume that both Pt^{2+} and Pt^{4+} ions are present in these melts.

The most important valency for palladium is the divalent state. The tetravalent palladium is less stable than the divalent palladium and also less stable than tetravalent platinum. Divalent palladium in solution is yellow. Similarly, yellow colors were formed readily in the alkali silicate, borate, and phosphate glasses, probably by Pd^{2+}.

Nearly all compounds of rhodium are trivalent. A few divalent compounds such as RhO and RhS exist, but the existence of tetravalent and pentavalent rhodium is questionable. Most solutions of the simple rhodium salts are orange to red. Rhodium in the glasses studied gave yellow, orange, peach and brown colors. It is quite probable, therefore, that trivalent rhodium is stable in these glasses.

This report of course, concerns the colors produced by the pure noble metals (most commercial linings, dies, etc. are usually produced from noble metal alloys) in simple glasses. Investigations of other glass compositions will be reported by the authors at a later date.

PITTSBURGH PLATE NAMES FIBER GLASS OFFICIAL

Donald K. Addie has been appointed production superintendent for Pittsburgh Plate Glass Company's Fiber Glass Division plant at Hicksville, Long Island, New York, according to an announcement by William Yahnker, plant manager.

Mr. Addie, formerly industrial relations assistant in the company's Pittsburgh office, joined Pittsburgh Plate in that capacity in 1952. A native of Sherbrooke, Quebec, Canada, Mr. Addie was graduated from McGill University in Montreal, Canada, where he earned a Bachelor of Science degree in mechanical engineering.

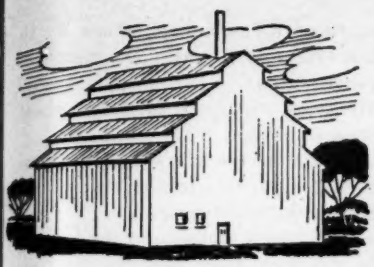
GENERAL REFRACTORIES CO., TO BUILD GARY, IND., PLANT

General Refractories Company announced plans for a new basic refractory brick manufacturing works at Gary, Indiana, to serve the important and expanding Mid-Western industrial area.

The new works will be located on an eighty acre tract within the City of Gary and will be served exclusively by the Elgin, Joliet and Eastern Railway Company.

At the Gary Works, GREFCO will manufacture its complete line of chemically-bonded basic brick.

The works is the result of many years of planning and will incorporate the most modern design and efficient equipment. Further, the works has been designed so as to allow for extensive expansion to keep pace with increasing demands for its products throughout this industrial area.



This glass plant is working even though you see no smoke

More glass plants switch to silicones

THE SUCCESS OF SILICONES in improving glassware manufacturing processes, providing better end products, and eliminating smoke, is working out for more and more manufacturers.

The glass industry itself, in cooperation with the Silicones Division of Union Carbide and Carbon Corporation, is bringing the applications of silicones to a practical reality under production conditions.

It has been clearly established, for example, that UNION CARBIDE LE-45 spray lubricant used instead of petroleum oil spray, can step up production as much as 4 per cent while lowering spray lubricant costs. At the same time, cleaner, shinier wear is produced.

Long-range advantages appear of equal importance. With the development of successful mechanical application methods for silicones, catwalks, beams, sheathing, and machines that used to be coated with oil and soot, will no longer be an invitation to flash fires. The use of silicones to lubricate delivery equipment—shear blades, scoops, chutes—and blank molds, can drastically reduce these soot problems.

Another advantage of the conversion to silicones is the prospect of reduction of the industry's high fire insurance rates.

In the accompanying advertisement you see the type of message that UNION CARBIDE has been running in national magazines like BUSINESS WEEK, SCIENTIFIC AMERICAN, CHEMICAL WEEK, and CHEMICAL AND ENGINEERING NEWS.

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UNION CARBIDE silicones brighten the glass picture

LOOK AT the reasons why

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But helping glass serve the tremendous business of bottling America's medicines, beverages, cosmetics, foods, is only one of the achievements of UNION CARBIDE Silicones. Many other industries are taking advantage of the "slipperiness," the strong resistance to heat and cold, the water repellency, and other useful qualities of this versatile family of chemicals.

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The term "UNION CARBIDE" is a trade-mark of Union Carbide and Carbon Corporation

Russian Translations . . .

(*Continued from page* 389)

oxide suspension showed an increase of glass abrasion of about 16 per cent.

Polishing in the presence of iron sulfate was standardized for the concentration of 3.8 g./liter and the pressure of the polisher equal to 80-90 g./cm^2. An increase of 2.5 times in the glass abrasion was obtained.

Refractories for Glass Furnaces

N. V. Solomin Promstroiizdat, Moscow 1953

(The number of pages and the price are not mentioned in the review, from which the following data are taken.)

The author of this book is the Head, Refractories Laboratory, All-Union Scientific Research Institute of Glass. The volume describes raw materials for refractories, various machines and furnaces used in the manufacture of the refractories for glass industry, properties and application of general and special refractories, technical specifications for these, and the methods of testing.

New information is given particularly in the chapters on the behavior of refractories in glass tanks and on the means of improving the resistance of refractories and the quality of the glass melt.

CLINTON F. HEGG PROMOTED

Clinton F. Hegg, vice president of the L. O. F. Glass Fibers Company, has been named general sales manager of the company, according to an announcement by R. H. Barnard, president. He was formerly in charge of the automotive sales division.

In his new post, Mr. Hegg replaces J. M. Johns whose resignation was announced earlier.

Mr. Hegg will headquarter at the firm's general offices in Toledo, directing sales activities in the automotive, textile mat and general products divisions.

A native of Minneapolis and a graduate of the University of Minnesota, he has been allied with the glass industry since 1939.

AMERICAN POTASH AWARDS SCHOLARSHIP

American Potash & Chemical Corporation has announced the winner of its $4,000 William J. Murphy Memorial Scholarship as John Charles Roberts III, of Boulder City, Nev.

The college scholarship was set up by the company in memory of William J. Murphy, AP&CC vice president in charge of Sales, who died last December.

Presentation of the award was made by Robert B. Coons, AP&CC vice president, Administration, during recent graduation exercises at Boulder City High School.

Young Roberts is the stepson of Thomas L. War, manager, Administrative Services, at the company's Henderson, Nev., electrochemicals plant.

Qualification for the four-year scholarship was open to children of American Potash & Chemical Corporation employees at its various facilities.

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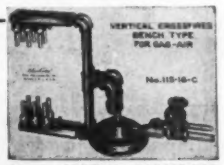
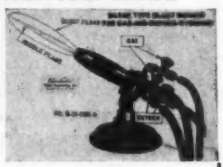


Above: SPECIAL CROSSFIRES
Below: BLAST BURNERS



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FOR THE GLASS INDUSTRY

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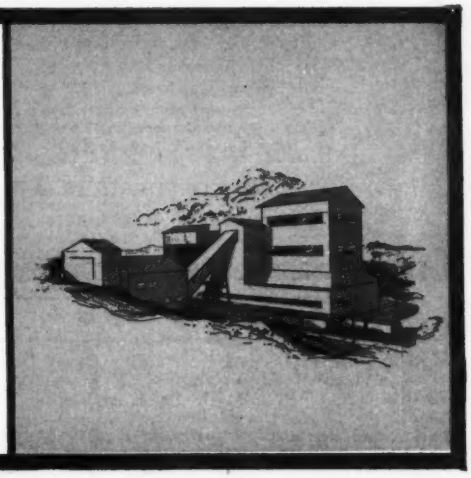

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GLASS RESEARCH ENGINEER: To develop electrical glasses; set up apparatus and measure glass properties; as volume resistivity and expansion. Will start as a one man department and grow with the company. N. Pritikin, Glass Products Company, 6911 S. South Chicago Avenue, Chicago 37, Illinois.

GLASS CHEMIST for research and development melting and work on technical production problems of unusual glasses, such as colored, radiation-shielding, silicate, phosphate, etc. Interesting salary. Report directly to General Manager, Penberthy Instrument Company, 4301 Sixth South, Seattle, Washington.

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WANTED: One J. P. S. Lynch Machine in good condition. Would also buy spare parts. Reply to Box 191, c/o THE GLASS INDUSTRY, 55 West 42 St., New York 36, N. Y.

J. P. ATKINSON PROMOTED

Joseph P. Atkinson, who has been in charge of Purchasing and Stores at the L. O. F. Glass Fibers Company plant in Parkersburg, W. Va., has been promoted to General Purchasing Agent of the company and transferred to the Toledo office. Mr. Atkinson succeeds Robert E. Ansted who has resigned.

ONE RETIREMENT AND FIVE PROMOTIONS AT L. O. F. OTTAWA PLANT

Mr. D. J. Cahill, Utica, assistant plant manager of Libbey-Owens-Ford Glass Company for the last 11 years and associated with the industry since 1923, recently retired for reasons of health and other considerations. Mr. Cahill will be accepting special assignments if and when his physical condition permits and will make available his counsel and experience to the Ottawa plant production management.

Five promotions in the management of the Ottawa, Ill., factories of Libbey-Owens-Ford Glass Company effective June 1 were announced by Curtis W. Davis, executive vice president—production, and R. R. Nickerson, plant manager at Ottawa.

The changes follow the decision of D. J. Cahill, of Utica, who has been associated with the plant since 1923 and has served as assistant plant manager since 1945, to retire at the end of May.

Ottawa plants will have two assistant plant managers effective with the changes. They are John W. Copeland, who has been serving as general superintendent of the Laminating plant, and Peter J. Kirkman, who has been production manager for the last ten years.

Other advancements in Ottawa plants include Albert N. Guthrie, plant engineer, who will succeed Mr. Kirkman as plant production manager; John D. Hemley, promoted to superintendent of the Laminating plant, and Lucien C. Strow, advanced to plant engineer at Ottawa.

J. H. COLE AND E. RUSSELL PROMOTED AT CORNING GLASS

Appointment of John H. Cole and Ernest E. Russell to new positions in B & C Factory at Corning Glass Works was announced by Floyd E. Hankey, plant manager.

Mr. Cole has been named production superintendent and Mr. Russell succeeds Mr. Cole as factory quality and process engineer.

Joining the company in 1951, Mr. Cole first served as a junior industrial engineer in the Optical Plant. He was named to a staff process engineering group in 1953 and last year was assigned to B & C Factory.

Mr. Russell became associated with Fall Brook Plant in 1951 and served successively there in the equipment engineering, machine maintenance, aperture plate and Multiform departments. He was named supervisor of equipment engineering at Pressware Plant last year.

DR. WEBSTER N. JONES JOINS PITTSBURGH PLATE GLASS

Dr. Webster N. Jones, formerly Dean of Engineering and Science and at present vice president of Carnegie Institute of Technology, joined the Pittsburgh Plate Glass Company at the end of this academic year, June 1, 1956. He will be associated with the corporation's Industrial Relations Department as advisor on the selection and training of professional personnel.

In his new capacity, Dr. Jones will furnish advice and counsel concerning professional personnel to the director of industrial relations and his staff. Dr. Jones will also serve in a counseling capacity on relations between the company and educational institutions, recruiting and selection indoctrination and training, and the evaluation of universities for further training of company executives.

R. L. DAVIS ELECTED SEC'Y.-TREAS. AMERICAN GLASSWARE ASSOCIATION

J. Nelson McNash, chairman of the Board of Governors of the American Glassware Association announced that the Board of Governors at its meeting, elected Richard L. Davis as secretary-treasurer of the Association.

Mr. Davis succeeds Mr. H. L. Dillingham who has served as the Association secretary-treasurer for 20 years, and having reached retirement age, has requested retirement effective July 1.

Mr. Davis has had 21 years of broad and successful experience in manufacturers trade associations which highly qualifies him for the position. Starting his career with the management engineering firm of Stevenson, Jordan & Harrison, he resigned in 1941 to accept the position of secretary of the Industrial Mineral Wool Institute which he organized from its inception. He also served as secretary-treasurer of the Perlite Institute and as Executive Secretary of the New York State Society of CPA's in recent years.

AMERICAN NEPHELINE EXPANSION COMPLETE

The huge two-and-one-half million dollar expansion program of American Nepheline, Limited's facilities at Nephton, Ontario, is now completed.

The expanded facilities include a new crushing plant, crude storage building, dryer building, mill and storage silos. The new mill will handle 600 tons per day, which is twice the former capacity. Space is provided for future expansion to 1,000 tons daily.

The American Nepheline, Ltd. deposit covers over 2,500 acres, and although not completely explored, is known to contain millions upon millions of tons. Sales of Lake Field nepheline syenite in the United States will be handled by the Ceramic Division of Great Lakes Foundry Sand Co., Detroit, Michigan.

WEYL LECTURES IN EUROPE

Dr. W. A. Weyl gave several lectures during his recent European tour. During his visit to Belgium, The Institut National du Verre of Charleroi organized three public lectures in which Professor Weyl discussed the following subjects: On May 28 "The principles of the theory of the screening of cations." On May 30 "General applications of the theory of the screening of cations." On June 1 "Applications of the theory of the screening of cations to glass and refractory materials."

Besides this, Professor Weyl lectured in Brussels on May 31 to the members of the Association Belge pour favoriser l'Etude des Verres et des Composes Siliceux, on the subject of "General consideration on structure, source of progress for scientific research."

The discussions which followed each of the lectures showed the great interest they had stimulated among those who attended.

• *ERRA TA*: Page 351, June issue, Vacuum Fabricated Glass article, the last three lines belong to the paragraph above so that the text reads as follows: "In order to rotate the glass tube and still maintain a good vacuum, an effective vacuum swivel must be used. An example of a good vacuum swivel is shown in Figure 7 . . . . . etc." On page 324 next to the last line, reference 9 should not have been listed after the name of Thorough.

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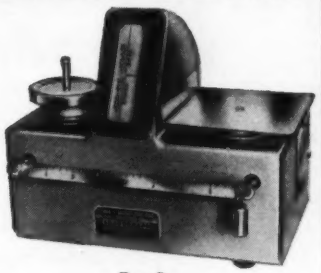

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SHADOGRAPH Scales are precision weighing instruments designed to meet the requirements of the glass industry for accurate control of both product quality and fluid capacities. Shado-edge indication, projected by a beam of light, eliminates all friction of indicating mechanism. Parallax readings are impossible. Special hydraulic damping action, plus short lever fall, brings indicator to rest quickly.

Models are available in sizes and capacities for every precision weighing job. They are widely used for compounding, batching and checkweighing glass products, such as bottles, flasks, etc. for quality control.

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TYPE A is designed for operations not requiring frequent changes of weights—fully enclosed with only the commodity platter exposed. TYPE B is recommended for frequent changes of weights and poise settings—has commodity and counterweight platters exposed with beam and poise on outside of scale. Both "A" and "B" Shadograph models are available in end or center tower designs. Write for complete details.

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